Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 74 NEW YORK, SATURDAY, AUGUST 12, 1916 Number 7

Helping the Young Engineer

APROPOS of the suggestions outlined in the Engineering Record of June 24 for improving the service which the American Society of Civil Engineers renders its members, it seems worth while to call attention to the part local associations can play in helping the young engineer. At the last meeting of the San Francisco Association of Members of the society it was proposed that once a year a meeting be held especially for juniors, whether affiliated with the association or not, with the idea of helping them broaden their acquaintance among their seniors. It was found that although 250 students in civil engineering have been graduated from two colleges near San Francisco in the past four years there are now registered in the San Francisco district only 74 junior members of the society, and of this small number less than 8 per cent have affiliated with the local association. Cause and effect in this situation are probably closely related. The San Francisco organization is a live one, however, and in the territory it serves this condition is being changed. Inducements to junior membership are to be offered and plans are being discussed. Through this sort of activity the society may expect to gain new members and strengthen its hold on the territory. The Pacific Coast is so far removed from the society headquarters that were there no local associations the society would make only an indirect, impersonal appeal to an engineer who did not find its publications useful and could not expect to command prestige by virtue of his standing in the society. That is particularly true of most of those eligible to junior membership.

Flood Protection for Erie

AFTER some big catastrophe there are a general bustling about of officials, countless inquiries and "probes" and other time-consuming formalities which drag along until finally the public forgets all about the matter until the next accident occurs. Occasionally, however, the lesson of a great disaster is taken to heart and constructive work done to prevent a repetition of it. A case in point is that of Erie, Pa., which was inundated by the flood in Mill Creek about a year ago. Thirty-nine lives were lost and the property damage was estimated at $3,000,000. Last week, on the date of the anniversary of the flood, flood-control works were formally inaugurated. The main feature of the project is a reinforced-concrete tube, 22 ft. wide and 18 ft. high, which will be bedded into solid rock the entire length of the city, about 2 miles, and will cost approximately $1,000,000. It is expected that the main portion of this work will be well under way this fall. With the completion of this project the flood menace in Erie will be effectively removed. There is a moral here for other cities where the possibility of flood damage still exists. Erie is profiting by its harrowing experiences of a year ago. Other towns can begin the construction of flood-prevention works now, without waiting for a toll in lives and property.

Failures in Army Examinations

WHY have so large a percentage of civilian candidates failed to pass the examinations for commissions in the Corps of Engineers of the U. S. Army? In some quarters this question is answered by stating that the tests have been unduly difficult —made so purposely, in fact, because of a reluctance on the part of the officers of the corps to admit citizens to this branch of the service. In the light of these comments and the fact that examinations for commissions in the corps are to be held week after next, the letter from General Black, on page 210, is interesting and timely. General Black disclaims emphatically any prejudice against the commissioning of technically qualified civilians. In fact, he has been making a special effort to secure a supply of officers from the country's leading technical schools. He holds—and in his contention he is supported by the dean of a prominent engineering college—that the examinations are not too severe. In his opinion the failure of 40 per cent of the candidates at a recent test must be accounted for either by the fact that the education now given by our technical schools is not thorough or else that the candidates who tried this examination were not really representative graduates.

Working with the Public

WHAT is the best way to convince a skeptical public that a certain municipal improvement is necessary, and to secure funds for its construction? Chicago's method is illustrated by the activities of its Association of Commerce in support of the plan for filtering the city's water supply and installing meters. The association publishes in the Chicago *Examiner* each week a four-column article on some civic subject. In the case of the water-filtration project an engineer of experience was employed to make the necessary investigations. The data were well digested and the resulting "stories" were examples of some of the best publicity engineering works in Chicago ever received. Coupled with the filtration proposition was a plea for meters, for Chicago wastes 60 per cent of the 250 gal. credited daily to each individual. Only one citizen in fifteen purchases water by meter. To engineers and waterworks officials no arguments for meters are necessary, but the layman must be educated to realize the necessity for their installation. Articles from authoritative sources such as the ones published in the Chicago papers will make the acquisition of desirable public improvements much easier. Other cities with similar problems could well afford to copy Chicago's publicity methods.

Engineer as "Silent Partner"

DURING the construction period of the Panama-Pacific Exposition engineers were made the executives in administering the $18,000,000 budget. The result was completion on time and within the funds assigned—a world's record. In the "destruction period," now well advanced, engineers are still handling the funds and managing the business affairs with great satisfaction to the exposition company. Dynamite is being used in a way which causes only slight loss of salvable material and makes it possible to get out the remainder for less than 1 per cent of what it would cost to dismantle and dismember the structures by hand. A review of the entire wrecking project is presented on page 203 of this issue. The executive responsibility intrusted to engineers in the exposition work marks a long stride toward a higher standing for the profession among financial interests; but with the less thoughtful public the engineer played his usual rôle of "silent partner." The monumental achievements of the engineering department were entirely finished, and for the most part covered up, before the opening date. Visitors came then to marvel at the work of sculptor, architect and landscape gardener, but comprehended little of the prodigious undertaking which the engineer had to carry out —the transformation of 600 acres of bay and tide flats into an "enchanted city," with every modern convenience. With the closing of the gates it was popularly considered that the exposition was history. Not so with the engineer. He had stood in the background during the festal season, but after the last visitor had gone decorations were stripped off and wrecking and salvaging operations transformed the exposition into a scene of devastation and chaos. The engineer is now fulfilling the second half of his commission to build up and then to tear down. His work will not be finished until the site is restored on the first of next year. Meantime it is his part to care little for the absence of popular attention and to find sufficient reward in showing a gross salvage income of $550,000, with a wrecking cost of only $250,000.

Admission to Reserve Corps

IN PRESCRIBING definite requirements for admission to the grades of first and second lieutenants, captain and major of the Engineer Officers' Reserve Corps of the U. S. Army the War Department has taken the initial step in building up a nation-wide organization of technically trained men as a defense measure. General Black's announcement on page 193 will be widely read by engineers who, during the past year, have been eager to place their services at the disposal of the nation. Before the National Defense Act was passed last month there was no official federal channel into which the military enthusiasm of engineers could be turned. Nevertheless this interest sought outlets through attendance at military engineering lectures, in courses of reading and in armory drill and outdoor maneuvers. Technical men who have participated in preliminary work of this sort now have an opportunity of receiving official recognition in the Officers' Reserve Corps.

The proper procedure to follow in applying for examination is explained in detail by General Black elsewhere in this issue. It is important to note that provision has been made for two grades of service—combatant and special. The former is intended primarily for the younger men of the profession, physically capable of performing rigorous duty at the front; the latter for the senior members, not so robust, but still well qualified technically to perform invaluable service on lines of communication, at sea-coast defenses or in other special duties. The age limits applicable to other branches of the Officers' Reserve Corps, as set forth in the new Army Act, do not apply to the engineer section, so that men of ripe experience in design and construction are eligible for appointment.

When the bill was first drafted a maximum age limit was specified which would have stripped the Reserve Corps of some of its most valuable material. At that time the Engineering Record, in an editorial, made a plea for the revision of this feature of the bill. Before the bill became a law this revision was made. The gates to the Engineer Officers' Reserve Corps are now open. Those who are qualified to pass them should lose no time in sending in their applications for examinations.

Business Basis Advocated for New York Street Cleaning

IT IS fairly certain that any private corporation engaged in work involving the regular employment of 7000 men and the expenditure of $9,000,000 annually would, first of all, decide upon a definite policy of administration for its business, then select as general manager a man qualified by past experience to produce results, and, finally, keep this executive in office as long as he "made good." The New York Street Cleaning Department is an organization whose activities are on precisely the scale outlined above. Yet during the last seventeen years its administrative control has changed, on an average, once every two years, while in the four-year term of one mayor there were five street-cleaning commissioners. The most astonishing fact, from a business point of view, however, is that of all the commissioners who have held office since the department was created in 1881 only one, the present commissioner, had any previous experience in conducting street-cleaning operations. These and other important facts are cited, in a report on New York street-cleaning methods and personnel, which Richard T. Fox has submitted to Commissioner John T. Fetherston, to indicate why so few improvements in personnel, methods of work or equipment have been made during almost a score of years, in spite of the fact that the department's employees have the highest pay and best working conditions, as to vacations, sick time and pensions, of any labor of this class in the United States. What New York City needs most, Mr. Fox finds, is a continuous street-cleaning policy, and this will be possible only when the commissionership is regarded as a job demanding expert qualifications and long tenure of office, rather than as a means for the payment of political debts. The taxpayers of New York, who are saddled with the burden of the city's huge bill for street cleaning and snow removal, will do well to give Mr. Fox's recommendations more than passing notice. It will mean money in their pockets.

So much for the general administrative phase of the department's activities. As to methods of work Mr. Fox makes a number of constructive criticisms, which are applicable to street cleaning in other cities as well as in New York. Under the present condition of affairs the cleaning and flushing of sidewalks is nobody's business. Mr. Fox would place this work under the control of the street-cleaning department. Few cities to-day, it is believed, follow this practice.

One of the department's most pressing needs is improved and up-to-date street-cleaning equipment. To-day there are available many improved mechanical devices, but no funds have been provided for their purchase, and, with a few exceptions, the methods of work and the equipment of to-day are the same as were used in Colonel Waring's time, seventeen years ago. Contractors in private practice have not been slow to avail themselves of the many labor-saving devices which manufacturers have developed in the field of general engineering construction. They realize that investment in first-class plant eventually results in increased profits, but in the case of the work of the New York Street Cleaning Department the municipal pursestrings apparently have been tightened regularly at any suggestion of purchases of improved equipment.

Mr. Fox finds need for a system by which the accountability of men and machines may fairly be fixed and by which comparisons of costs may be made. Another of his suggestions is that a school of instruction for both officers and men, dealing with the best methods of work and the best use of equipment, be encouraged. This is highly desirable, and it could be organized somewhat on the lines of noncommissioned officers' schools in military organizations.

If city officials with appointive power really wish to give the people the "business administration" which they promise so glibly in their stump speeches before election day, they must realize that real efficiency is not a mushroom growth. It is the result of continuous application in the investigation and study of organization, of the control and direction of men, of scientific methods of work and of equipment. This general principle applies not merely to street cleaning but to the operations of all public-works departments.

Intelligent Publicity

TIME-HONORED custom dictates that when a railroad suffers a wreck, or a washout, or a bridge collapse, the company's officials, big and little, immediately assume a clamlike attitude. They know nothing about it, or the reports have been greatly exaggerated, or a statement will be issued later—"later" being far enough off so that the public will have lost interest and will be content with a short cut-and-dried story. Meanwhile reporters, photographers and other born maligners of the hapless railroad are held off, as far as possible. And by this very means the railroad company goes far to convince the public that whatever the accident or its cause the railroad was to blame.

A most interesting violation of tradition has been committed by the Cincinnati, New Orleans & Texas Pacific Railway, better known as the Queen & Crescent route. Last week's issue of this journal, page 170, described the replacing of a span of that company's bridge over the Tennessee River, destroyed by a blow or blows from a shifted load on a car. This description and the illustrations were taken from a 52-page booklet issued by the railroad company, labeled "Accident at Tennessee River Bridge."

Eight pages are devoted to a short account of the accident itself, being followed by a complete story of the repair work. Pages 9 to 51 inclusive are full-page views of the successive stages of reconstruction, while on the last page are the names and titles of the thirty-eight officials "who took part in removal of wreckage, rebuilding of span and handling of traffic." True, the booklet is addressed to the officers of the Queen & Crescent route, but the copy that came to this office was not accompanied by instructions that it be kept under lock and key and read only in a dark room. And yet, think of the risk the company took! The very word "accident" puts it on the defensive. What right has a railroad to have accidents? Are they not proof of inefficiency and watered stock? If the evidence was incontrovertible that the bridge span was knocked down and did not merely fall down from overwork, it may be asked how the load on the car came to shift. In fact in certain advanced localities—advanced in railroad baiting—the question why the bridge was not designed to withstand such blows as it received would probably be heralded as highly pertinent and public-spirited.

The Engineering Record is glad, nevertheless, that the Queen & Crescent decided to run this risk and give out the facts of the case in such an interesting way. The public is bound to be benefited by the truth. The engineering world is enlightened by the account of how the bridge was repaired so quickly. The men who effected the repair are helped by the credit given therefor, and this in turn must inure to the railroad by improving the *esprit de corps*. The example of the Queen & Crescent is a shining light. Will other roads follow it?

A Step in the Right Direction

THE Rio Grande irrigation project is one of the number of privately controlled projects which were taken over by the United States Reclamation Service. Projects of this type, it will be remembered, were severely criticised in the report of the Central Board of Review in its discussion of the Carlsbad project, and also by this journal when it commented upon the board's review in its issue of July 15, page 66. To just what extent speculative interests have profited on the Rio Grande project this journal does not know. The organization, however, by the Elephant Butte Water Users' Association of a co-operative land selling bureau, for the express purpose of eliminating the speculator and his methods, indicates that he was probably just as much a pest and an obstacle to the best progress of the project that he has proved on other government developments, either wholly or largely under private ownership. The step of the Elephant Butte Water Users' Association is in the right direction, and a knowledge of what it is doing is, therefore, of interest to all engineers who follow the progress of private and public irrigation work.

The scheme is extremely simple. Owners of land on the Rio Grande project have been invited to list their properties, when for sale, with the secretary of immigration of the association. The secretary, in turn, endeavors to get in touch with those seeking to buy land, and when he has located a prospective purchaser he takes him immediately to the landowner, and negotiations, therefore, are directly between the principals. The brokers and the speculators, who have little thought for the ultimate success of those who settle on the project, are eliminated. Furthermore, since the secretary of immigration is a representative of all of the water users, and therefore concerned in the success of the project as a whole, it is to the interest of his employer—the whole community—to see that the prospective settler gets a tract on which he will probably "make good" and be an asset in the upbuilding of the community. The water users' association well knows that the projects profit nothing if settlers come in, lose all they have and are obliged to abandon the land. Under the speculators' system the holdings again enter the market and once more a failure crop is the result.

The immigration secretary is not interested—at least primarily—in selling land. His business is to secure promising settlers, home makers, community builders. Consequently he interests himself in the available capital of the prospective settler, in his experience, even in his mental attitude. He advises him against taking a holding that is beyond the financing power of his operating capital. He tries to find a farm that will yield best under the newcomer's previous experience. Such a course, it is needless to say, if persisted in will be a boon to the project. It has not been in operation long enough to warrant much talk about results, but in its brief life of about a year it has fulfilled the expectations of its promoters—has been a home-finding rather than a real-estate speculating bureau. It has received the endorsement of the Reclamation Service and has become the pattern of similar co-operative land-selling bureaus on several other projects.

The West knows well the value of co-operation. Its purchasing and selling organizations are the model for the agricultural sections of the entire country. Moreover, new ideas get a respectful hearing much quicker there than they do east of the Mississippi River. Once, therefore, the benefits of co-operative land selling are fully demonstrated, there is but little doubt that bureaus established to apply the scheme will appear on practically every project. Many of the mistakes that have been made in our reclamation policy cannot be rectified, but there are enough left that will yield to sounder policies, firm administration and co-operation of the right-minded settlers to bring about a new era in our irrigated West.

The speculator must be eliminated, the Central Board of Review said. The co-operative land selling of the Elephant Butte Water Users' Association is the first important step in that direction.

The Other Eighty Per Cent

A MOVEMENT that may go far toward convincing Congress of the folly of the present lack of legal restraint on the four brotherhoods of railroad men, though started scarcely two weeks ago, is rapidly gathering momentum. The movement is a monster petition to Congress from the 80 per cent of railroad employees not members of the brotherhoods. It points out that they are threatened with curtailment of income by the proposed general strike and that they, as well as the general public, have a clear and definite right to be protected against such destructive methods of a few; and it urges "that some definite legislative action be taken whereby the vast majority of the people of the country shall be protected from a destructive interruption of interstate commerce due to the wholly selfish action of a small group of men, and that all differences which may arise between railway and employee shall be settled by proper arbitration. In this way," concludes the petition, "you would recognize the fundamental principle of the republic that no small group of men ought to be permitted directly or indirectly to conspire to an end calculated to benefit them only and directly or indirectly work wrong and loss upon the great majority."

If this petition accomplishes anything, as the Engineering Record hopes it will, a liberal measure of credit must go to Robert T. Frazier, an engineer in the valuation department of the Nashville, Chattanooga & St. Louis Railway. He was the originator of the plan, and no longer ago than July 27 he secured the first signature to his petition. In four days he states that 5500 signatures had been secured on his own road, and then he went to Chicago. Two days' work brought him 4000 Rock Island signatures, and at the end of a third he had enlisted lieutenants to cover the Chicago and St. Louis railroads. This journal's representative saw him shortly after he reached New York, where he hoped to conduct a similar campaign before proceeding to Philadelphia, Baltimore and Washington. There is no day-to-day canvass of the signatures, and it is not known how many have been secured. It is hoped, however, that in a very short time 100,000 will have signed, when the petition will be submitted to Congress.

Two points emphasized are that the movement does not attempt to pass judgment upon the merits of the trainmen's contentions, but only points out the unfairness of their peremptory methods, and that it is strictly an employees' movement. At the same time it has the approval of the railroad managements, for its success will benefit the companies as well as the 80 per cent and the public.

The signatures represent employees of low and high degree. Of about 1400 in the main shops of the Nashville, Chattanooga & St. Louis, 1289 signed. On the other hand, the name of at least one high official of the road can be found there.

As this page goes to press the crisis in the basic eight-hour demand of the trainmen is at hand. The vote of the trainmen, announced Tuesday, was overwhelmingly for giving the brotherhood leaders authority to declare a strike if they saw fit. The leaders have "put it up to the railroads," and the railroads have not yet replied. Pressure will doubtless be brought to force the brotherhoods to arbitrate, but there is grave doubt as to the outcome.

Whether or not the 80-per cent movement started in time to be effective in the present crisis, it seems admirably designed to spur a dilatory Congress to action. The men are not organizing to make any demands on the railroads. To do so would only antagonize their employers to no good end, as their demands would hardly reach the public. The railroads are not fathering the movement; if they were they would be accused of clouding the trainmen's issue. It is the voluntary act of the 80 per cent and the weight of their signatures that ought to make their impress on public opinion and Congress. The petition simply points out in a sane way what nobody who stops to think can gainsay, and the number of signatures, if the campaign is as successful as it bids fair to be, will be striking proof of the large number of men and families concerned. The Engineering Record wishes the movement speedy and complete success.

Steel Spans and Concrete Arches Combined to Form Unusual Bridge at Ninetieth Street, Cleveland

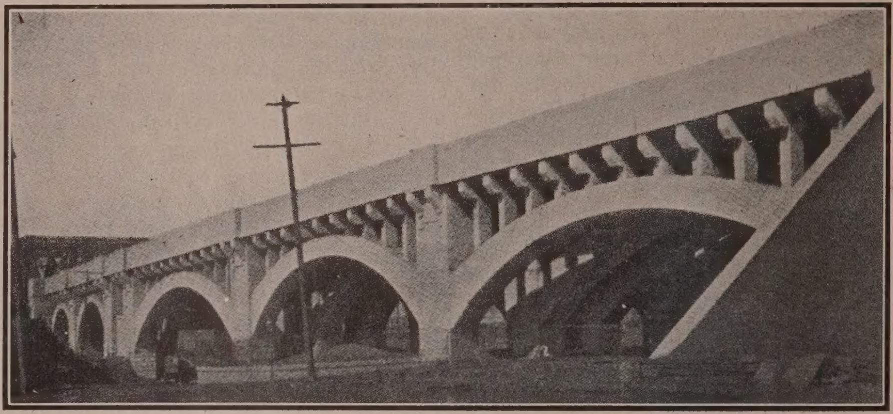
Spans Crossing Diverted Holton Avenue and the Pennsylvania Tracks Are So Limited by Clearance Requirements That Complex Skew Construction Is Necessary

OWING to the unusual conditions fixing overhead and lateral clearances in the layout of the four-track bridge of the Cleveland & Youngstown Railroad crossing East Ninetieth Street, Holton Avenue and the Pennsylvania Railroad in Cleveland, it was necessary to adopt steel-truss and deck-girder spans in combination with reinforced-concrete arches. In one case steel deck-girder spans for the two north tracks are contrasted with the concrete arch spans carrying the two south tracks.

The limits in clearance, both overhead and lateral, were fixed by the necessity for carrying the two sets of double tracks of the Cleveland & Youngstown Railroad over the Pennsylvania Railroad and over Holton Avenue, as well as Ninetieth Street, with the additional requirement that provision should be made for the future depression of Holton Avenue to pass under the Pennsylvania tracks. It will be seen by the plan view herewith that both abutments and all piers are skew structures, that Holton Avenue had to be diverted in order to make the crossing feasible and that variable span lengths for the arches were a necessity. The special construction of the piers and the details of the 82-ton double cross-girder supporting the expansion ends of deck girder spans are illustrated.

GENERAL PLAN AND LAYOUT

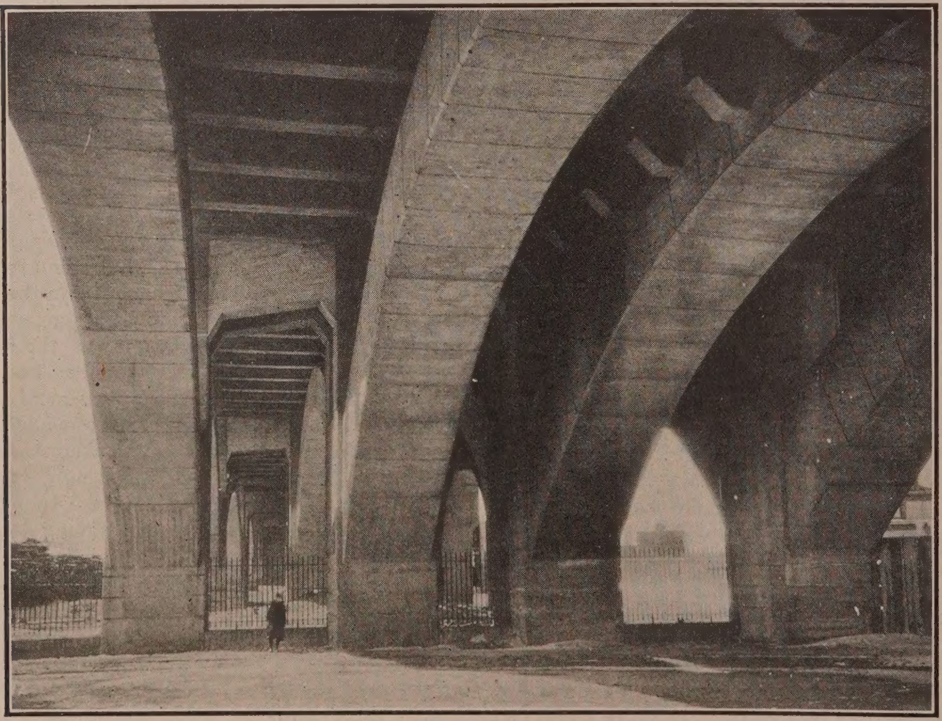
The four-track bridge of the Cleveland & Youngstown electric railroad is built as two adjacent double-track structures practically independent of each other except at the through-truss span over the Pennsylvania Railroad tracks, where three main trusses are used—two of the same length, 147 ft. 3 in., and one 170 ft. 4½ in. long on account of the skew. The next spans to the east are deck-plate girders of 109-ft. span for the north track, deck-plate girders of 53-ft. span for the next track to the south and two arch ribs with a reinforced-concrete beam-and-slab floor for the two south tracks. As shown by the plan, clearance over Holton Avenue is provided by cross-girders supporting the ends of the deck-plate girder spans indicated on the drawing.


FIVE CONCRETE ARCH SPANS AT EAST END OF BRIDGE SEEN FROM THE SOUTH

In general, reinforced concrete was found to cost no more than steel, and it was used wherever possible. Limited by the side and overhead clearance requirements, reinforced-concrete arch spans were adopted for the east end of the bridge. The most easterly span, of 88 ft. 4 in. clear opening, crosses East Ninetieth Street. Where the piers were too close for arches, a solid paneled connecting wall, of effective design, was used, as seen in the elevation and in one of the photographs. Separate piers for each of the four arch ribs were built on monolithic foundations, as illustrated by Pier 1.

The bridge was designed for Cooper's E-60 live loading, using the specifications of the New York Central Lines, 1910, with the exception that impact was allowed for on the steel spans by a formula giving lower impact factors; that is, a factor of $225/(L + 300)$ was used instead of $300/(L + 300)$.

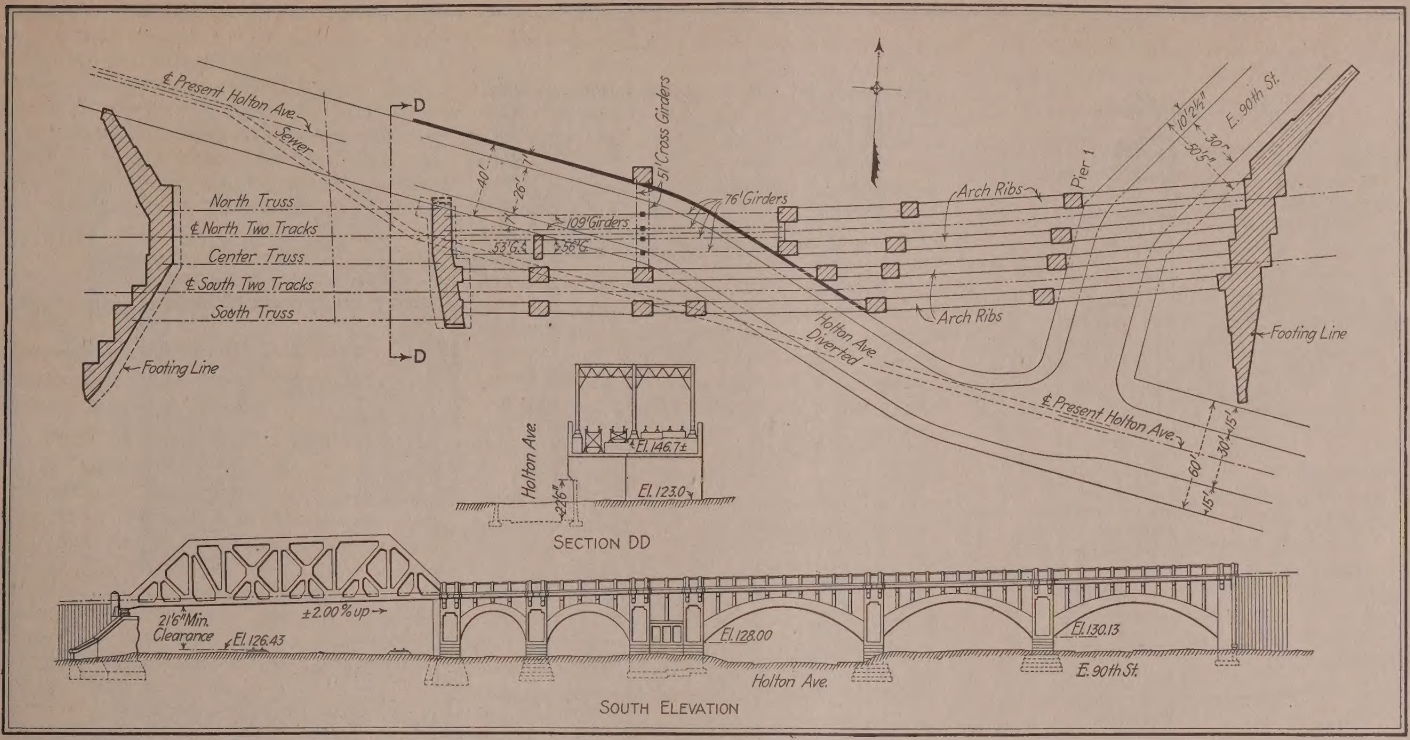
For the concrete parts of the structure an impact of 50 per cent was adopted, and the unit compressive stress in concrete caused by combined bending and direct thrust was kept within 650 lb. per square inch. An allowable shear in the concrete of 50 lb. per square inch was used.


VIEW FROM EAST NINETIETH STREET LOOKING WEST SHOWS FOUR RIBS AT PIER 1

TRUSS AND GIRDER SPANS

The west span over the railroad tracks consists of three subdivided panel trusses of standard type, with Bethlehem I-beam stringers, the panel lengths varying from 14 ft. 7½ in. to 18 ft. 2⅜ in. All trusses are 32 ft. deep between centers of chords, providing 22 ft. overhead clearance and 7 ft. 6 in. side clearance for the trains crossing the structure, and 21 ft. 6 in. minimum clearance above the tracks below, which will be raised in the future to allow Holton Avenue to be carried beneath them. A timber open floor is used on this part of the bridge, with 2-in. planking outside of the tracks, and maximum open spaces of 1 in.

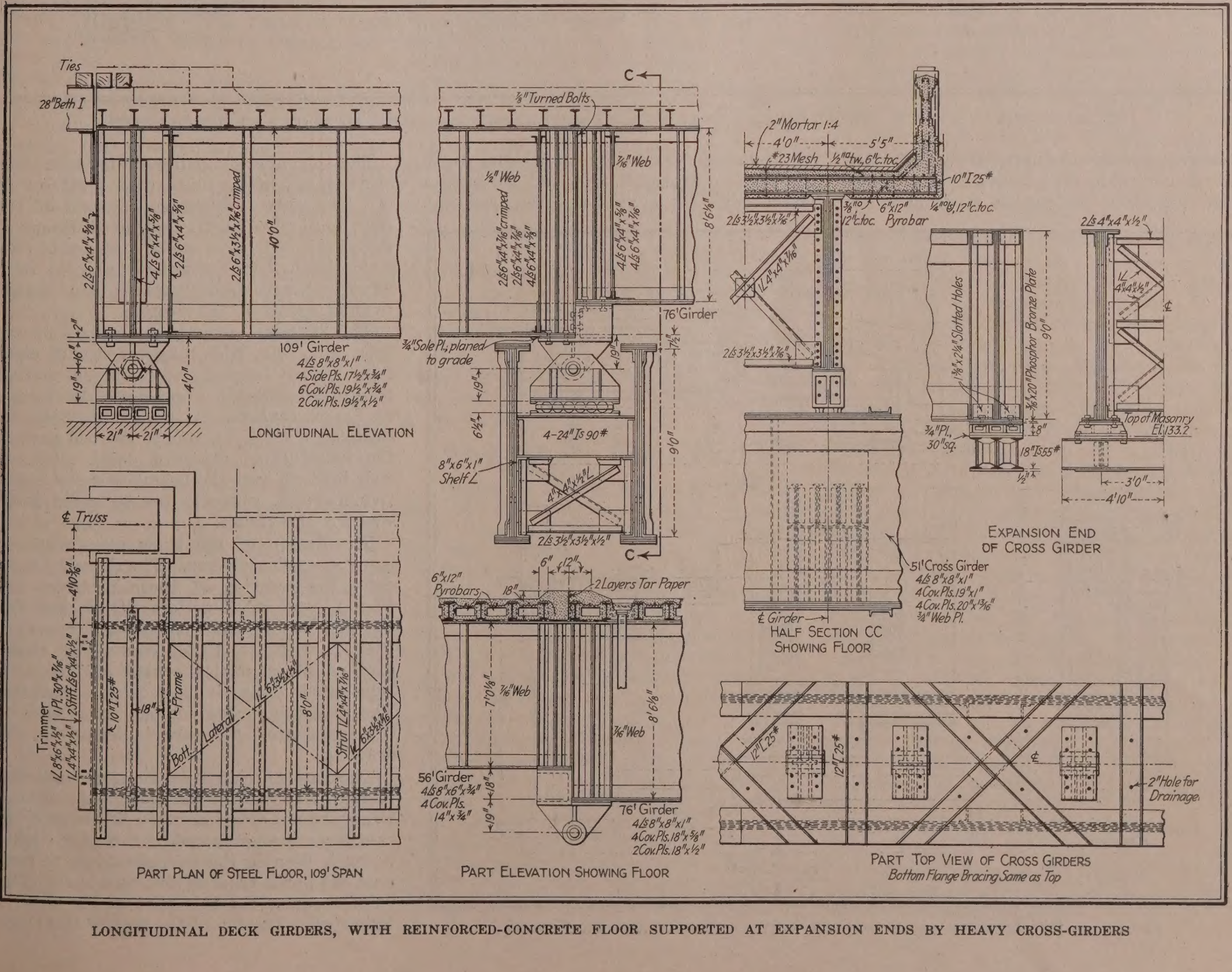
The deck-plate girder spans are also of typical construction, except the reinforced-concrete floor, which is lightened by the use of 6 x 12-in. pyrobar between the steel beams in the reinforced-concrete slab deck. As shown on the plan view and the detail drawing, varying span lengths fixed by clearance requirements for Holton Avenue, which located the piers, had to be adopted. The 109-ft. girders for the north track were made 10 ft. deep and supported at the expansion end on 51-ft. cross-girders over the street, as noted. The other spans, of 53, 56 and 76 ft., for the girders were made as economical as the conditions permitted.



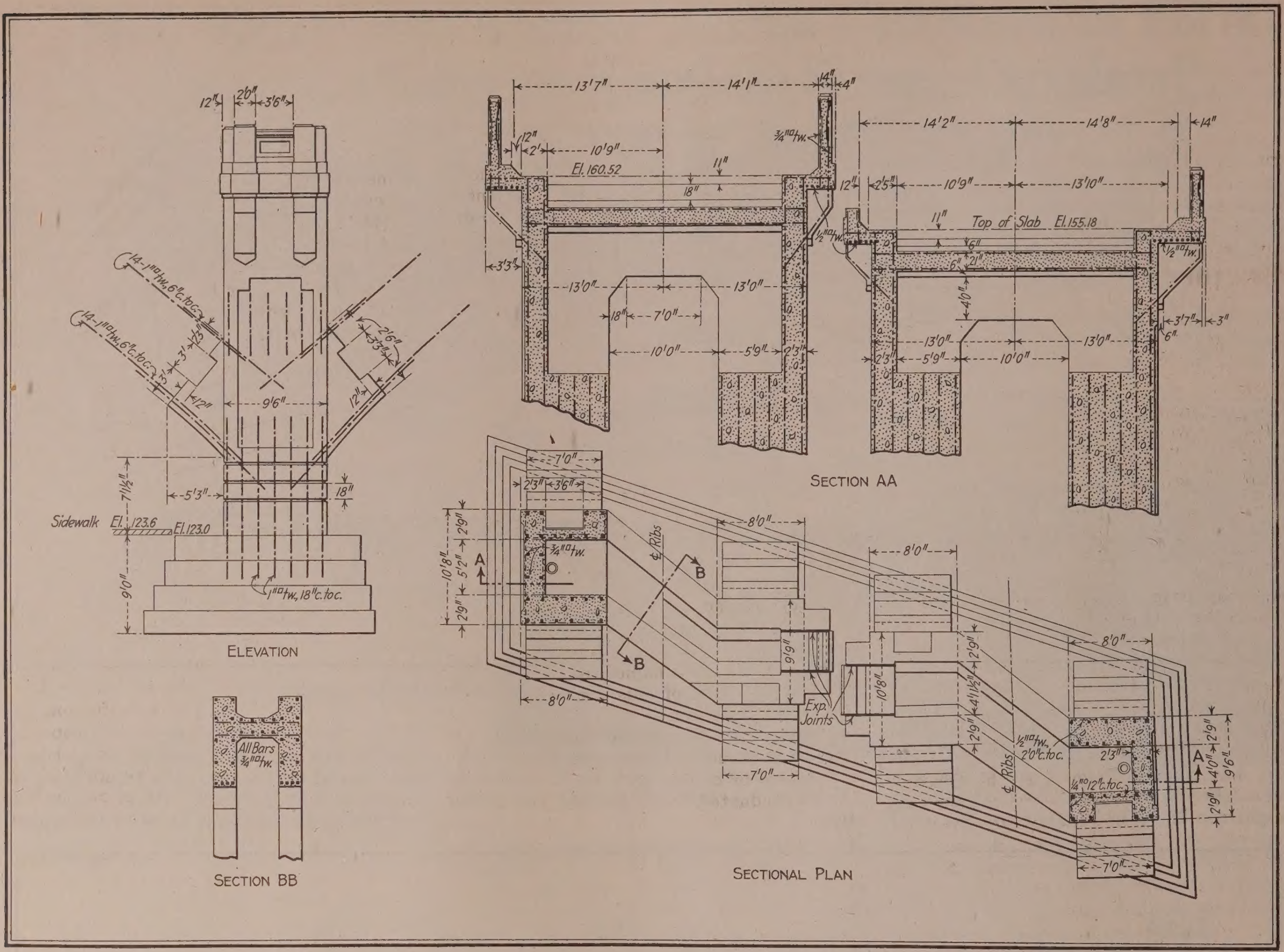
PLAN AND ELEVATION SHOW INFLUENCE OF CLEARANCE REQUIREMENTS ON DESIGN

The heavy 51-ft. cross-girder, 9 ft. deep, composed of two plate girders on 6-ft. centers, was riveted up complete in the shop and shipped to the site. The total shipping weight was 82 tons. As shown in the detail drawing, this cross-girder carried the expansion pedestals of the main girders, the roller nests resting upon 1¼-in. plates on the 24-in. I-beams between the two girder webs.

The top and bottom flanges of these two girders are securely braced by 12-in. channels spaced to clear the pedestals of the longitudinal girder spans. Cross-frames below the girder seats and an end cross-frame,

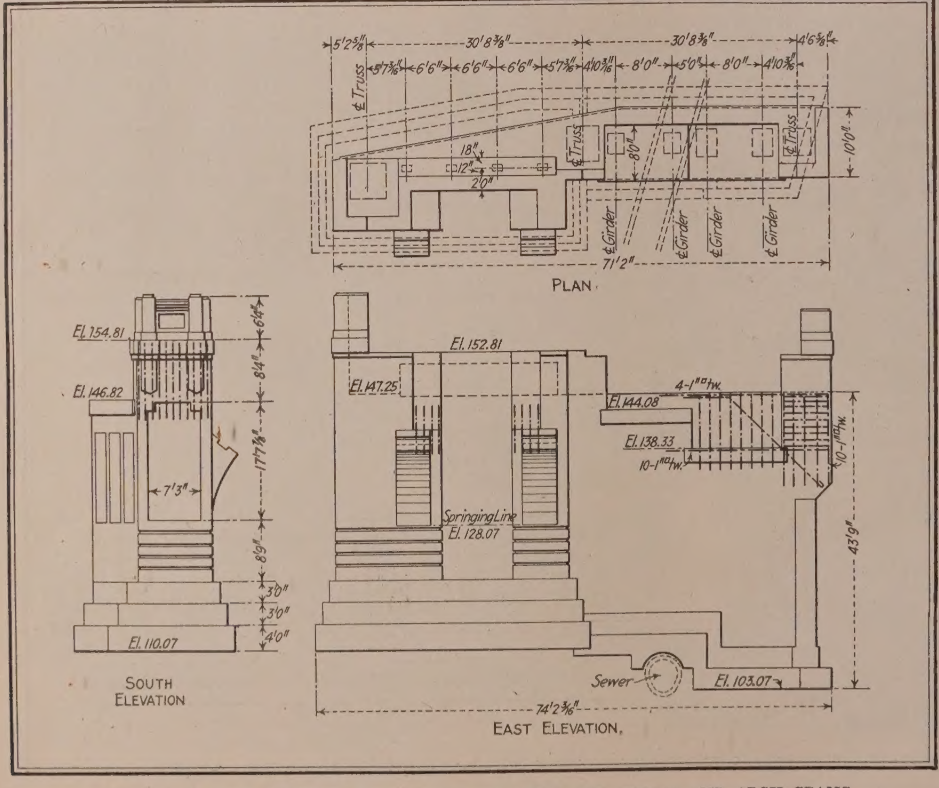


LONGITUDINAL DECK GIRDERS, WITH REINFORCED-CONCRETE FLOOR SUPPORTED AT EXPANSION ENDS BY HEAVY CROSS-GIRDERS



DETAILS OF PIER 1, SHOWING SPECIAL CONSTRUCTION, WITH MONOLITHIC BASE SUPPORTING SEPARATE ARCH-RIB PILASTERS

as shown, provide the necessary rigidity for unsymmetrical loading caused by expansion. Cast-steel shoes designed to conform to the requirements for girders of unequal depth are used to transmit the load through a 9¼-in. pin to the built-up steel pedestal.



DETAILS OF PIER BETWEEN TRUSS SPAN ON WEST AND GIRDER AND ARCH SPANS

The typical arch span is 88 ft. 4 in. clear between springing lines, with a rise of 19 ft. The crown thickness of each of the four main ribs is 5 ft., and the thickness at the pier is 8 ft. 3 in. The ribs are of constant width, 7 ft. throughout, and the reinforcement consists of fourteen 1-in. square twisted rods top and bottom.

The spandrel columns are of the usual type, 3 ft. 6 in. wide, reinforced with eight 1-in. square twisted rods, and supporting reinforced-concrete transverse floorbeams on 7½-ft. centers. A slab 11 in. thick, reinforced with ¾-in. square twisted bars in the longitudinal direction, with alternate rods bent up over the beams to resist negative moment, supports the ballasted roadway for the tracks.

The design of the skew piers involved many special problems. The drawing indicates the solution of these problems for Pier 1, west of Ninetieth Street, and for the east pier of the Pennsylvania crossing. Pier 1, with its double connecting cross-girders and economical central opening with reinforced walls, is particularly complex. The projecting rods for the connection of the main arch ribs are indicated in the drawing.

The lateral clearance requirements for Holton Avenue at the east pier of the Pennsylvania crossing made it necessary to cantilever the north end of this pier slightly, as is seen in the east elevation, to support the north truss of the west span. The reinforcement for this part of the pier is indicated. The top of the pier, with bridge seats at various elevations for the truss and the girder span, is further complicated by the stringer seats for the two south tracks.

The bridge was designed by Wilbur J. Watson & Company of Cleveland, bridge engineers of the Cleveland & Youngstown Railroad, of which W. E. Pease is chief engineer. The contractor was the Walsh Construction Company, and the structural steel was fabricated by the American Bridge Company.

Engineer Officers' Reserve Requirements Fixed

General W. M. Black, Chief of Engineers, U. S. Army, Explains Proper Procedure to Follow in Applying for Commissions

REQUIREMENTS for admission to the Engineer Officers' Reserve Corps of the U. S. Army, for which provision was made in the new National Defense Act, have been fixed by the War Department. The following information regarding the procedure in making appointments to this branch of the service has been sent to the Engineering Record by Brig.-Gen. W. M. Black, Chief of Engineers, U. S. A.:

A copy of the complete regulations will be furnished on request, which should be addressed to the Chief of Engineers, U. S. Army, Washington, D. C.

PRINCIPAL REQUIREMENTS

Applicants commissioned in the Officers' Reserve Corps will rank in the various sections according to grades and to length of service in their grades. Commissions will be issued for periods of five years. No age limits apply to the Engineer Officers' Reserve Corps.

Except as otherwise herein provided, a member of the Officers' Reserve Corps shall not be subject to call for service in time of peace, and whenever called upon for service shall not, without his consent, be so called in a lower grade than that held by him in said reserve corps. In time of actual or threatened hostilities the President may order members of the Officers' Reserve Corps, subject to physical examination, to temporary duty with the Regular Army, or as officers in volunteer or other organizations that may be authorized by law, or as officers at recruit rendezvous and depots or on other duty. They may be promoted to vacancies in volunteer organizations or to temporary vacancies in the Regular Army, as prescribed in the act. While reserve officers are on such service they shall be entitled to the pay and allowances of the corresponding grades in the Regular Army.

Department commanders and the chief of engineers, when authorized by the Secretary of War, may order reserve officers of their departments or corps to duty with troops in the field or at field exercises or for instruction for periods not to exceed 15 days in any one calendar year. While so serving such officers shall receive the pay and allowances of their respective grades in the Regular Army. These periods will not be extended except with the consent of the reserve officers concerned.

Enlisted men of the Regular Army and of the National Guard, both active and retired, if citizens of the United States, are eligible for examination for commissions in the Engineer Officers' Reserve Corps. No applicant will be examined who is an officer of the Regular Army on the active list or of the National Guard or who is not a citizen of the United States.

The examining boards will ordinarily be composed of one officer of the Corps of Engineers, one member of the Engineer Officers' Reserve Corps, and one officer of the Medical Corps or Medical Officers' Reserve Corps.

The mental examination of no applicant will be undertaken who, in the judgment of the board, is not physically qualified to discharge in active service all the duties of an officer of the grade in which the applicant seeks a commission in the Officers' Reserve Corps; nor of anyone who has any mental infirmity or deformity of body, or whose moral fitness has not been duly established.

No person shall be examined for appointment in the Engineer Officers' Reserve Corps unless he has a letter from the Chief of Engineers authorizing his examination. Such a letter to an applicant will be the acknowledgment of the receipt of his application.

If an applicant has served in the Regular Army of the United States, or in any of the volunteer forces of the United States, or in the organized militia of any state or territory or the District of Columbia, he shall submit his discharge papers for each term of service; if still in service of any of the organizations named, he shall submit recommendations of his immediate and higher commanders.

If an applicant has attended or pursued a regular course of instruction in any military school or college of the United States, or has graduated from any educational institution to which an officer of the Army or Navy has been detailed as superintendent or professor pursuant to law, he shall, if a graduate, be required to present a diploma or certificate of graduation from such military school, college, or educational institution, or, if not a graduate, a certificate showing the amount and character of training, theoretical or practical, satisfactorily completed thereat.

Every applicant will be subjected to a rigid physical examination, which shall include the ordinary analysis of the urine, and if there be found to exist any cause of disqualification which might in the future impair his efficiency as an officer, he will be rejected. Defects of vision resulting from errors of refraction which are not excessive, and which may be entirely corrected by glasses, do not disqualify unless they are due to or are accompanied by organic disease.

COMBATANT AND SPECIAL SERVICES

Candidates for appointment in the Engineer Officers' Reserve Corps will be examined either (a) for duty with combatant Engineer troops or other duties in the service of the front, or (b) for special service on the lines of communications or other points in rear, including Engineer work in connection with seacoast defenses, as hereinafter indicated. Officers appointed under (b) will not ordinarily be assigned to combatant duties, but will be subject to such assignment whenever needed. The examinations shall be especially directed to ascertain the practical capacity of the applicant, and the record of previous service and training of the applicant shall be considered as a part of the examination.

Military experience or training in the Regular Army, Volunteers, or National Guard, or at training camps or educational institutions will be noted and reported by the board and considered in making the recommendations.

(A) Qualifications for reserve officers, service of the front:

FIRST AND SECOND LIEUTENANTS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or have qualified for the grade of junior engineer, civil, electrical, or mechanical or higher grade in the civil service, or he must be a graduate from an approved engineering college, or have been in the active practice of engineering for at least two years.

CAPTAINS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or be eligible for the grade of assistant engineer in the Engineer Department at large, or a corresponding Engineer grade in the civil service in another department of the government service, or have held a commission in the Corps of Engineers of the Regular Army, or shall be a professional engineer not less than 28 years of age, who shall have been in the active practice of his profession for at least eight years and have had responsible charge of work as principal or assistant for at least two years. The graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years' active practice.

(c) Knowledge of the principles of military organization and operations, as illustrated in Infantry Drill Regulations, Parts I (to include School of the Company) and II, and Field Service Regulations, Part I and Part II (Articles I, II, IV, VI); and of the general principles of field fortifications, as illustrated in the Engineer Field Manual, Chapter V.

MAJORS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must hold the grade of Assistant Engineer in the Engineer Department at large, or corresponding Engineer grade in the civil service in another department, or have held a commission in the Corps of Engineers of the Regular Army not more than two grades below that for which he desires to be listed, or shall be a professional engineer not less than 35 years of age, and shall have been in the active practice of his profession for fifteen years, who shall have had responsible charge of work for at least five years, and shall be qualified to design as well as to direct engineering work. Graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years of active practice.

(c) In addition to fulfilling the qualifications given in paragraph 3 (a) and (b), the candidate will be required to pass an examination on the following subjects:

Drill Regulations—Parts I (School of the Company and Battalion only), II, III, Infantry Drill Regulations.

Field Service Regulations, entire text.

Duties of Engineer officers and troops in war, as illustrated in the Engineer Field Manual and Bulletin No. 4, Vol. I, of the office of the Chief of Staff.

Co-operation between the various arms of the service, as illustrated in "Technique of Modern Tactics" (Bond and McDonough), Chapters VIII, IX, XI, and XII.

All examinations will be oral.

(B) Qualifications for reserve officers, special services:

Candidates desiring appointment in special services must be qualified for at least one of the duties assigned to the Corps of Engineers by the following extracts from Army Regulations:

"1493. The duties of the Corps of Engineers comprise reconnoitering and surveying for military purposes, including the laying out of camps; selection of sites and formation of plans and estimates for military defenses; construction and repair of fortifications and their accessories; . . . the installation of electric power plants and electric power cable connected with seacoast batteries; . . . construction and repair of military roads, railroads, and bridges; military demolitions; . . . In time of war within the theater of operations it has charge of the location, design, and construction of wharves, piers, landings, storehouses, hospitals, and other structures of general interest, and of the construction, maintenance and repair of roads, ferries, bridges, and incidental structures, and of the construction, maintenance, and operation of railroads under military control, including the construction and operation of armored trains."

LETTER OF APPLICATION FOR EXAMINATION FOR COMMISSION IN ENGINEER OFFICERS' RESERVE CORPS

........, 19...

The Chief of Engineers, U. S. Army,
Washington, D. C.

Sir: I have the honor to apply for examination for a commission as (1)......of Engineers, in the Officers' Reserve Corps, organized under the authority of Congress.

I have served......years in (2).......

I have pursued a regular course of instruction for ....years in (3).......

I graduated in the year....from (4)......., after having creditably pursued the course of military instruction therein provided.

I was born........, 1.., and am (5)....a citizen of the United States. My business is .... My experience is..

(6) I inclose letters of recommendation and addresses of three citizens who know me, as follows:

....
....
....

Respectfully,
....

Permanent P. O. Address:..........................

The correctness of the statements above made was sworn to and subscribed before me, ..., 19...

(7)..........,
....
....

(1) Insert grade—1st or 2d Lieutenant, Captain or Major.

(2) Insert service in Regular Army of the United States, or volunteer forces of the United States, or Organized Militia of any State, Territory, or District of Columbia; also state in what capacity.

(3) Insert name and location of the school or college.

(4) Insert name and location of the educational institution.

(5) Insert "not" if in accordance with fact.

(6) If a member of an engineering society, state society and grade of membership.

(7) Oath to be taken before, and signature to be made by, officer authorized by law to administer oaths.

No oral or professional examinations will be required, but recommendations of boards will be required in lieu of such examinations. Candidates will submit evidence of their actual employment in corresponding or higher positions in civil life and references to persons under whom they have been or are employed. The boards will communicate with such persons and with any others that they deem fit, and upon all the evidence submitted or otherwise obtained will base their recommendations and recommend the appropriate grades for which they deem the successful candidates qualified.

Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers: Bridge engineers; constructing engineers (earth and concrete); constructing engineers (wharves, piers, and buildings); electrical engineers (for small plants and power lines); highway engineers; mining engineers (skilled in tunneling and use of explosives); railroad engineers (construction and maintenance); railroad operating officials; sanitary engineers; topographical engineers.

Special Strain Gage Has One-Piece Welded Frame

D. E. Hooker, of Seattle Building Department, Designs Instrument for Measuring Reinforced-Concrete Buildings

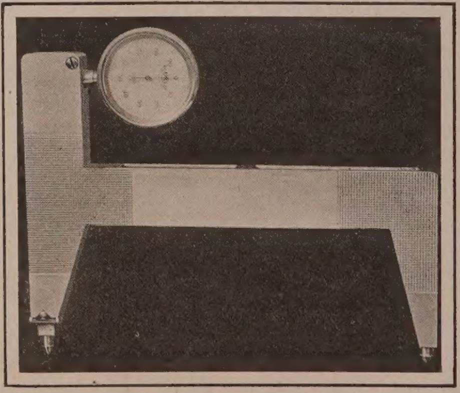
A SPECIALLY constructed strain gage to measure strains in reinforced-concrete buildings has been purchased by the Seattle Building Department from Prof. H. C. Berry of the University of Pennsylvania. The unusual features of this Berry gage include a frame without rivets or screws, the side plates being joined to the spacing lugs by the electric welding process; checkered side plates to give a better grip for the hands; a clearance of 3 in. to enable readings to be made on steel embedded deep in the concrete, and a special fulcrum joint for the movable leg.

The one-piece frame is so rigid that side pressure, given unconsciously when making observations, has comparatively little effect on the readings, and there are no rivets or screws to work loose or throw unequal interior strains in the frame. The 3-in. legs allow measurements on the deepest layer of steel in four-way flat slabs and the checkered plates reduce the strain of continued reading by giving a better grip of the hands on the instrument.

TRUNNIONS HELD BY SPRING

The trunnions of the movable leg are held up into position in the notches of the frame by a spring, guarded by a cover plate. Both the spring and the cover plate are square, with a square hole in the center of each through which the movable leg passes. The cover plate is held in place by four countersunk screws, which are screwed home in the frame, and thus have no tendency to work loose.

As the instrument is to be used only in testing buildings, the gage length is fixed at 8 in., this length being considered most practicable for general use. It is constructed throughout of invar steel. The dial can be revolved any part or all of a revolution to eliminate parallax in reading on floors, ceilings or columns, and to permit the dial end of the instrument to be held in either the right or left hand. The dial is an Ames gage, graduated to thousandths of an inch, and as the proportions of the movable leg are one to five, the instrument records strains of 0.0002 in.



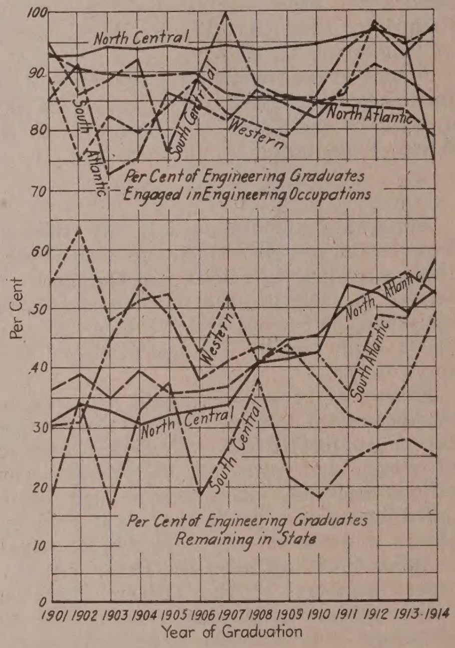
STRAIN GAGE WITH ONE-PIECE FRAME

The complete instrument is shown in the photograph herewith. The gage was designed by D. E. Hooker, assistant superintendent, Seattle Building Department, and constructed by F. F. Metzger, of Philadelphia.

Graduates in Engineering Hold to Profession

Investigation Shows That More Than 90 Per Cent Remain in Engineering—About 60 Per Cent Leave States Where Educated

CONTRARY to generally expressed opinion, only a small percentage of graduates of engineering schools leave the profession, according to the results of an investigation of more than fifty representative engineering colleges in the United States made by A. A. Potter, dean of the division of engineering, and M. R. Bowerman, instructor in machine design, Kansas State Agricultural College. Nearly 23,000 comparatively recent graduates (from 1901 to 1914 inclusive) whose occupation and residence were known, including all sections of the country, have been included in this investigation, and the result by sections is shown on the accompanying diagram.



PERCENTAGES OF GRADUATES REMAINING IN ENGINEERING AND IN STATE WHERE EDUCATED

The total general average of all graduates shows that 90.1 per cent of all the graduates for these years remain in engineering occupations as practising engineers, engineering draftsmen and designers, construction engineers, engineering salesmen, teachers of engineering and engineering executives. Of the total graduates, only 41.1 per cent remained in the state where they were educated—a fact of great significance to the state institutions largely supported by state taxation. The diagram shows, however, that larger percentages of the northern and western sections where such state institutions are found remain in the state where their education was received.

Arched Gravity Dams to Be Built at Lower Otay and Barrett Sites

San Diego City Council Accepts Recommendation in Report of M. M. O'Shaughnessy for Immediate Construction of Two Dams

SINCE the failure of the Lower Otay dam on Jan. 27, noted in the Engineering Record of Feb. 12, page 225, San Diego, Cal., has faced the necessity of immediately providing new reservoirs in which to store the city's water supply. M. M. O'Shaughnessy, city engineer of San Francisco, was retained as consulting engineer to advise the city in the matter, and his report to the city council of San Diego recommends the immediate construction of two arched gravity dams, one to be built at the point where the Lower Otay dam formerly stood and the other to be at Barrett site on Cottonwood Creek. This report was accepted by the city council on July 17, and arrangements are being made for the required bond issue.

The principal features of Mr. O'Shaughnessy's report are presented in the following extracts:

TWO EXCELLENT SITES AVAILABLE

"At present the city owns in fee simple two excellent dam sites, available for immediate occupation and use, namely, Barrett and Lower Otay, and I recommend that work on these sites be immediately undertaken.

"A reservoir at Barrett, with 7,000,000,000 gal. capacity, will more than conserve 7,000,000 gal. daily average waste now taking place at that point from lack of adequate storage, and is the cheapest stored water that can be added to San Diego's supply. The dam at Lower Otay, besides collecting water from its adjacent watershed, can also be used to hold such overflow from Cottonwood Creek as may be diverted by the Dulzura conduit, and conserve the same in a balancing reservoir within 20 miles of San Diego.

"There has been a substantial amount of preliminary work finished for the two above-named sites, such as roads which make the work readily accessible, diversion tunnel, partial foundation explorations, the Dulzura conduit from Barrett and the pipe line and distributing branches from the Lower Otay. Should the city of San Diego attempt to initially utilize some of the other available sites, of which there are several in the county, practically all of the above-mentioned work or its equivalent would have to be duplicated, water rights and rights-of-way would have to be obtained either by direct purchase or condemnation proceedings, with the consequent legal entanglements, etc.—all of which would entail unnecessary expense and delay at this time.

"The city should therefore realize the importance of immediately beginning and diligently prosecuting the work on the Barrett and Lower Otay dams in order to meet the needs of the rapidly increasing population.

BARRETT DAM GIVEN PREFERENCE

"The most desirable program of construction would be to carry on both dams simultaneously. However, should the city decide to build only one dam immediately, I recommend that Barrett dam be given preference. The Barrett reservoir would act not only as a balancing unit for the Lower Otay reservoir, but would also make full use of the completed Dulzura conduit and bring into immediate service the water now wasting at Cottonwood, thus supplying a very desirable link in the ultimate plan of development.

"It is clearly evident from the location and physical characteristics of these two watersheds, and from measurements heretofore made, that the runoff from Barrett is, in normal years, much more than that from the Lower Otay shed, while exactly the reverse is true of the available economic storage at the two dam sites—15,000,000,000 gal. at Lower Otay and 7,000,000,000 gal. at Barrett. This condition demands that the excess waters of Barrett reservoir be transmitted by means of the Dulzura conduit and stored in the Lower Otay. This in turn will make available more storage space for waters from the Cottonwood shed.

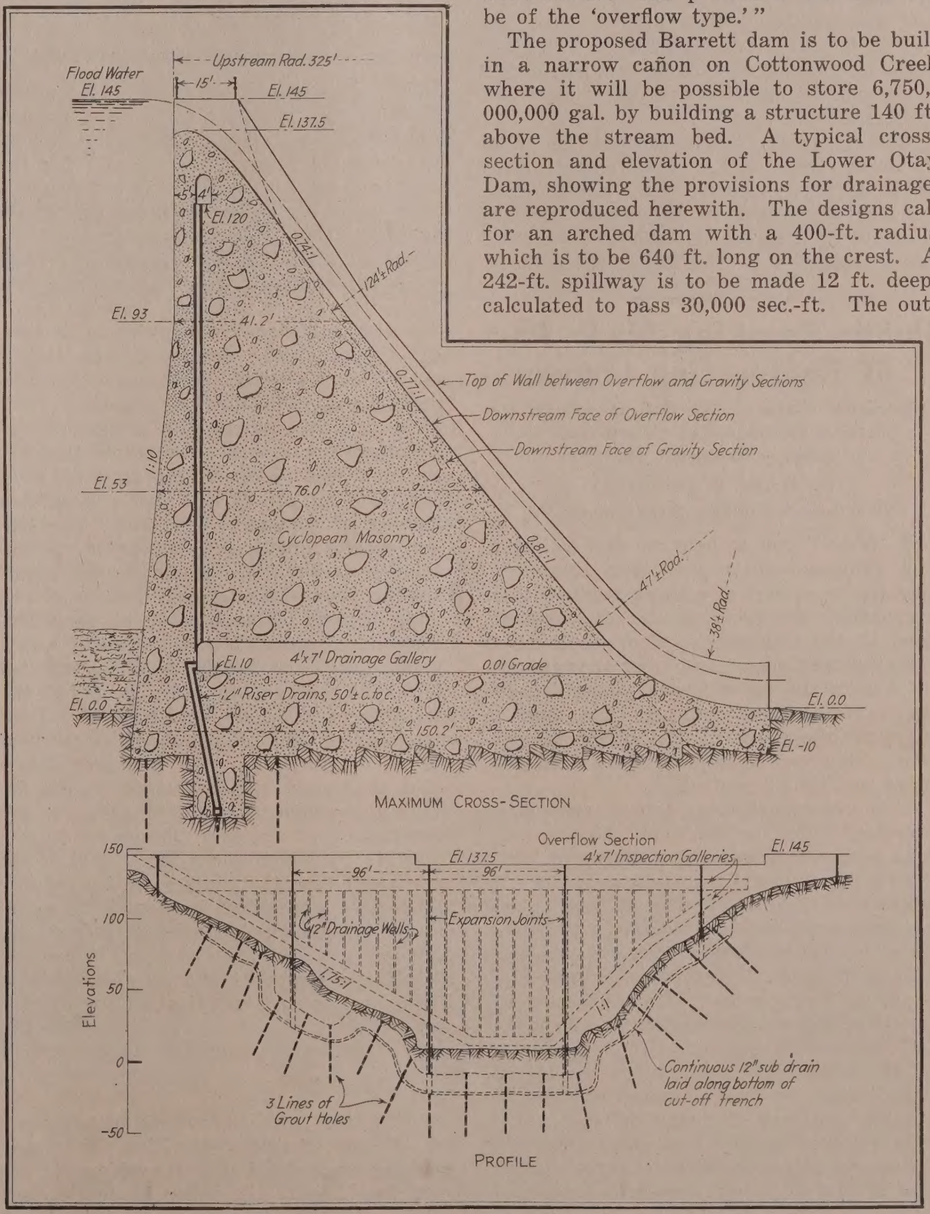
"With these two dams built, a much more complete utilization of the waters from the two sheds now in city ownership will be possible, and the available city supply will be increased in average years by approximately 10,000,000 gal. per day.

"If the Barrett dam alone be built at present, the stored water from the same can be passed down to the Upper Otay and the lower smaller city reservoirs near San Diego and practically directly into the city distributing system by the direct connection to the Dulzura conduit.

TYPES OF DAMS

"The type of dam proposed for both the Barrett and Lower Otay sheds is the 'arched gravity, cyclopean concrete.' Previous exploration work at the two sheds (for the original dam in the case of Lower Otay) has proved that the foundations are amply able to withstand all the pressures and thrusts which may develop. These pressures will not exceed 10 or 11 tons per square foot for either structure. For both dams there is a central portion made lower than the remainder in order to pass the flood waters. This portion of the dams will be of the 'overflow type.'"

The proposed Barrett dam is to be built in a narrow cañon on Cottonwood Creek where it will be possible to store 6,750,000,000 gal. by building a structure 140 ft. above the stream bed. A typical cross-section and elevation of the Lower Otay Dam, showing the provisions for drainage, are reproduced herewith. The designs call for an arched dam with a 400-ft. radius which is to be 640 ft. long on the crest. A 242-ft. spillway is to be made 12 ft. deep, calculated to pass 30,000 sec.-ft. The out-



MAXIMUM CROSS-SECTION AND LONGITUDINAL ELEVATION OF LOWER OTAY DAM
Barrett dam is designed with exactly similar outlines and provisions for drainage.

let tower is provided with 30-in. valves for drawing off water either at the bottom of the reservoir or at a point 45 ft. above. From the tower the water flows in a tunnel around the west end of the dam and empties into the main channel below. A concrete roadway 15 ft. wide is to be built along the crest of the dam, supported on piers across the spillway section. The volume of masonry required in the dam will be about 89,000 cu. yd. and the cost is estimated at $690,400.

PROPOSED LOWER OTAY DAM

The proposed Lower Otay dam is to be built on the site of the structure that failed last January. At this point a dam 137.5 ft. above stream bed will afford a storage capacity of 15,000,000,000 gal. Mr. O'Shaughnessy recommends an arched dam with a radius of 325 ft. and which will be 750 ft. long on the crest. The section, illustrated herewith, is to be very similar to that of the Barrett dam. The outlet tower will be provided with 24-in. valves for drawing off water at four levels to be passed through a 48-in. steel pipe set in concrete-lined tunnel. It is planned to concrete the inside of this pipe later. The spillway capacity is to be 26,000 sec.-ft. and the roadway will be carried across its 267-ft. length on concrete piers. The volume of the dam will be approximately 86,000 cu. yd. and the cost is estimated as $682,200.

The probable time required for constructing these dams is estimated to be about 15 to 18 months if the construction of both is carried on simultaneously. If they are built in sequence the time allotted for construction is from 30 to 36 months.

Public Speaking Made Part of Engineering Course

"Discussion Classes" Are One of Several Departures Introduced at Swarthmore to Develop Executive Ability

By MARC P. DOWDELL
Swarthmore College, Swarthmore, Pa.

"I WANT you to help me find a fifteen-thousand-dollar man for this job," said the president of a large public-service corporation to Prof. George F. Blessing, head of the department of engineering at Swarthmore College, a number of years ago.

"What's the matter with Jones?" asked the professor, referring to the man in charge of the technical work of the corporation. "It seems to me that he is admirably fitted to fill your position."

"I've been considering Jones," replied the president, "but he won't do. He's a first-rate mechanical man; but the man I am looking for must be something more; he must have technical ability, of course, but his chief work will be executive, and he will have to be especially prepared to meet boards of trade, town councils and other bodies of business men. He will have to do this impressively—be a creditable representative of our company."

The president searched for more than three months before he found the man he could pay fifteen thousand dollars a year. This incident deeply impressed Professor Blessing and he began to examine his department to see what were the business qualities of the students he was graduating. He immediately discovered that few of them could talk in public, that very few of them could stand before a class and explain an engineering problem with ease or assurance; they hesitated, and stammered, and made anything but clear-cut recitations. On inquiring of Prof. Paul M. Pearson, head of the public-speaking department, he learned that there were few engineering students enrolled in public-speaking courses.

"I have been working on a plan," said Professor Pearson, "which I think will help to solve your problem. Public speaking should be a valuable study for every student who intends to enter business or professional life, and next year we will begin a course in extemporaneous speaking which will have such students especially in mind."

"That's the very thing I want," said Professor Blessing. "I want my men to learn to talk about their business in public; I want them to be able to talk about engineering so that an ordinary audience can understand them and be interested in what they have to say."

Professor Blessing kept his promise to send his students to enroll in the new course. The other departments had also been consulted about it, and they, too, seized the opportunity. Students crowded "Public Speaking 88," as it was officially known, from its very inception.

PUBLIC-SPEAKING CLASSES ORGANIZED

The method employed in this course was to divide the class into sections of a half-dozen students each. They studied at first an outline text written especially for the work in hand, but commenced actual practice in speaking almost with the first meeting of the class. Each department of the college furnished a list of subjects from which the students drew suggestions, and the instructors encouraged "talking shop"—at first only for five minutes at a time, but as proficiency developed, for longer periods, until twenty-minute extempore speeches wound up the year's work.

The students named the conditions for their speeches in every case before they began, and were judged according to what they tried to do. "I will give a toast at a chamber of commerce luncheon," one student would announce, whereupon the remainder of the class would resolve itself into the group of supposed "lunchers" and would demand to be entertained, congratulated and convinced that the speaker was a "good fellow" and that his business was "all right." Salesmanship often occupied the attention of the class, and many a bill of merchandise was disposed of to critical boards of directors. An engineer interested in certain improvements on his father's farm gave a series of talks on the construction of sanitary pig pens. A girl interested in grand opera spent most of the year in telling the stories of the operas which were appearing from week to week. Economics and political-science students expounded the doctrines of every school of belief, from Herbert Spencer to H. G. Wells. Biologists spouted "survival of the fittest" and "evolution." After each speech the class spent a few minutes to discuss it and to decide whether it was a success or a failure.

While the public-speaking department solved one of his difficulties, Professor Blessing worked out several problems in his own department. In order to develop executive ability among the men he introduced a system of shop accounting designed according to the principles of the Emerson school of scientific management. The men made their first acquaintance with this system through actually "ringing in" on the time clock. At first they did not take very kindly to it, and a second supply of "demerit slips" had to be ordered from the printer in a very short time; but the students soon began to be more careful, and "demerit slips" became a rarity. In operating the system the department provided that every man spend some part of his time in the shop office, where he learned to see efficiency methods from the executive's point of view.

Professor Blessing also introduced "discussion classes" for all the junior and senior engineers. In these classes the students met their professors informally and brought up practical problems encountered in laboratory or field work during the week. The students did the talking, and helped one another to solve the difficulties. Quite frequently the professors absented themselves, or when they did attend, did more listening than talking. Comfortable leather upholstery of the engineering library furnished the environment for these classes, and perhaps helped create the atmosphere of a conference between factory foremen and the shop superintendent.

PERSONAL-RECORD CARDS

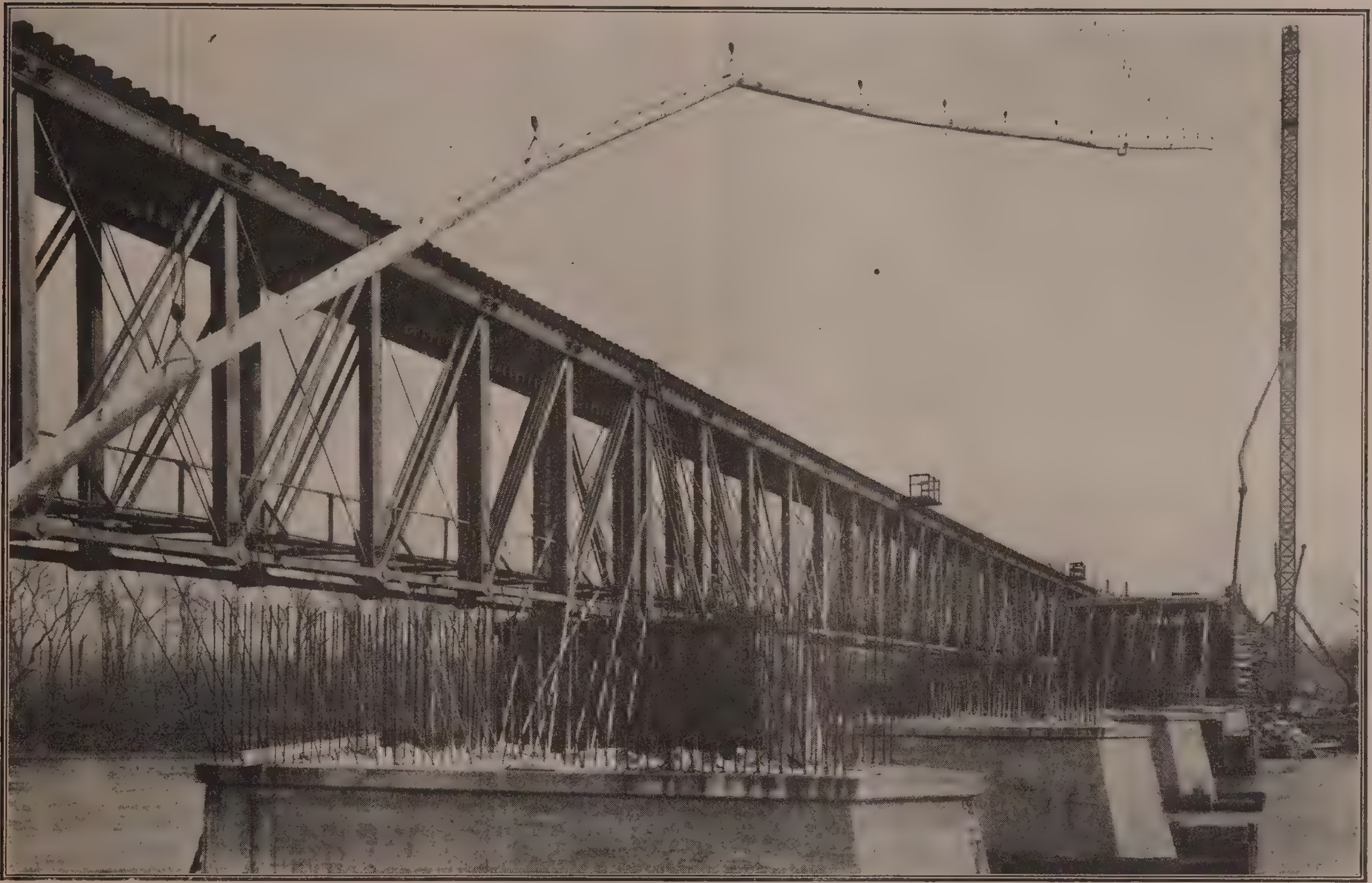
This is the system as thus far developed; but beginning next year a file of "personal-record cards" will enable Professor Blessing to keep track of every phase of the activity of his men. In addition to the record of a man's scholarship, these cards will provide space for "extra-curricular" activities. If he belongs to a fraternity, the card will state that fact; if he becomes manager of the *Phœnix*—the student weekly—or manager of an athletic team, or a player, his card will show that fact. At the end of four years the department will have an accurate index of the qualities of the man. Professor Blessing will be able to tell whether any particular man will be likely to make good as an executive, and will be able to place him in line for such a position; while, on the other hand, he will know whether his man is best suited to enter a field where technical ability alone will count.

It has taken six years to bring this work of Professor Blessing's to its present stage—too short a time to foretell just what percentage of improvement it is effecting. A judgment based on the qualities of the undergraduates themselves points to its success. The enthusiasm these men display toward their work is greater than the enthusiasm of any other group of students in the college. Recent graduates, placed since this system has been working, have made exceptionally good records for the short periods of their employment. The houses which employed them are asking for more Swarthmore graduates. The next decade, however, will show the real results of this work. It will require a long period for the men now graduating to reach their high planes of earning power, and when they do, many of them will be found in the fifteen-thousand-dollar class.

Gasoline Engines May Supplant Mules

Gasoline engines are being tried as a substitute for mules on road work near Sherman, Tex. Demonstrations in two precincts have shown that the amount of work accomplished with mules is just half of that when gasoline engines are employed.

Interesting Concrete Plants Illustrate Modern Methods



Tall Spouting Plant Used on Railroad Bridge

Main Tower 280 Feet and Tail Tower 110 Feet High Place Concrete in Arch Structure Across River at Pottstown, Pa.

PERHAPS the highest concrete tower on record has been used in building the bridge of the Pennsylvania Railroad across the Schuylkill River at Pottstown, Pa. The double track, reinforced-concrete arch bridge contains seven 84-ft. spans.

Five of the piers were constructed in cofferdams, the shale rock being about 12 ft. below normal river stage. The other pier and the abutments did not require cofferdams. One of the coffers was made with a single row of steel-sheet piling, and the other four consisted of double lines of wood sheeting filled with cornstalks and clay. The excavation was handled by a derrick boat built at the site.

The concrete plant at the base of the main tower was located 100 ft. south of the south abutment at the base of the existing railroad fill. A side track over the material bins made it possible to dump sand and stone into them from railroad cars, but little stone was received in this way. A quarry was opened about 500 ft. from the plant, and stone, brought to the mixer in narrow-gage cars, was hoisted into the bins by a stiffleg derrick using a clamshell bucket. Cement was shot direct to the charging platform from cars on the siding or from the cement shed at the same elevation.

The tail tower was located about 800 ft. from the main tower on the opposite bank of the river. The north abutment, near the base of this tower, was 750 ft. from the main tower. Concrete was distributed from three points on the main tower, depending on the distance it had to be spouted. It is stated that the chutes worked satisfactorily on a slope as flat as 1 to 2.7.

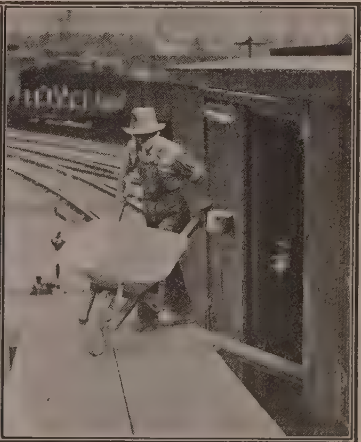
The piers were completed first through the umbrella sections. The arches were then poured, one at a time, the full double-track arch being poured in one operation. Each complete arch is poured in three sections, varying from 70 to 400 cu. yd. each.

The bridge is being built for the Pennsylvania Railroad by the James McGraw Company of Philadelphia.

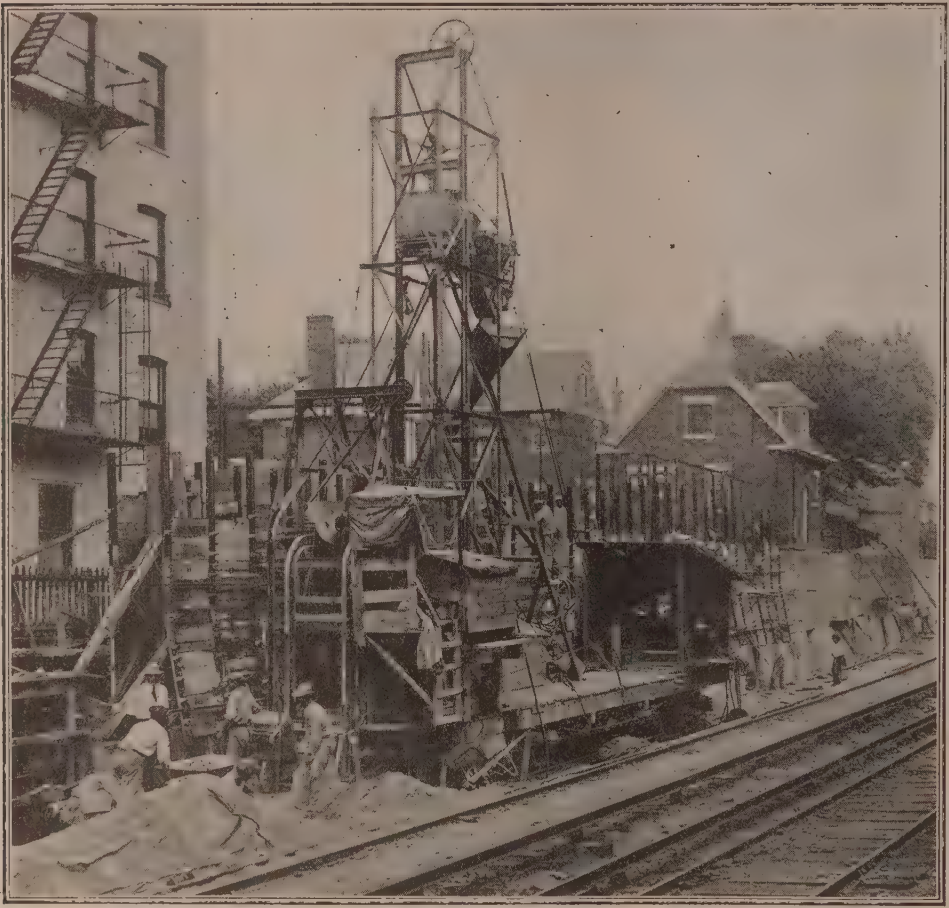
Mixer Train and Novel Bucket Handled by Crane Used at Baltimore & Ohio's Chicago Freight Terminal

BUCKET FOR THIN WALL FORMS

CROSS-RUNWAYS KEPT LOADING FROM DELAYING WHEELERS



BULK CEMENT WAS USED HERE

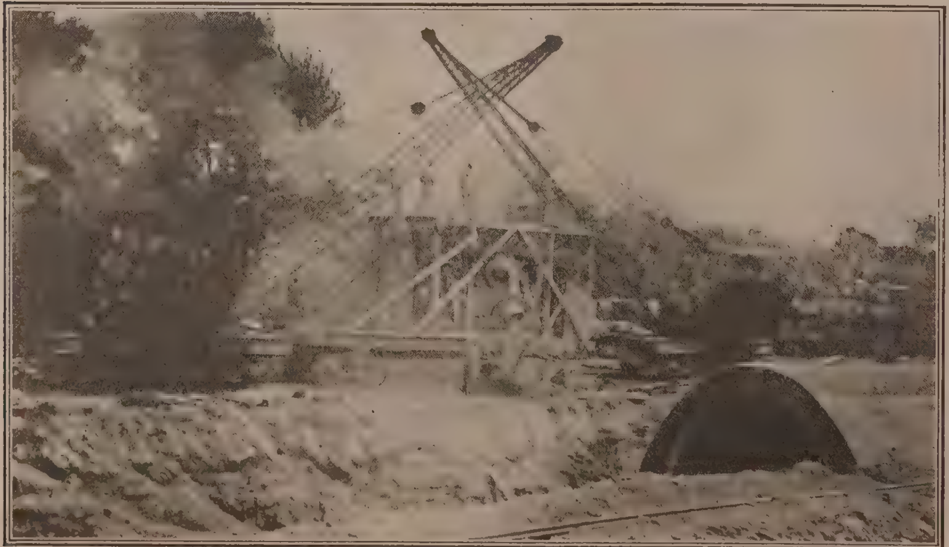


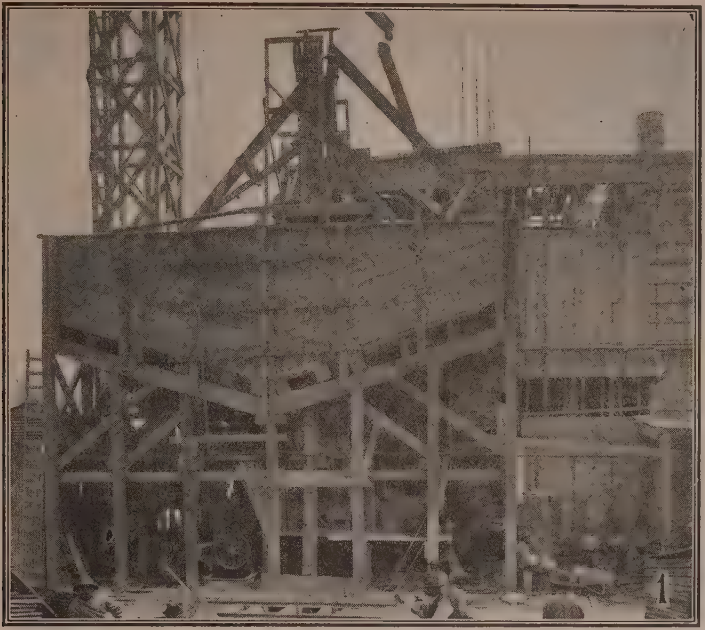
Concrete Plants in the Vicinity of New York City

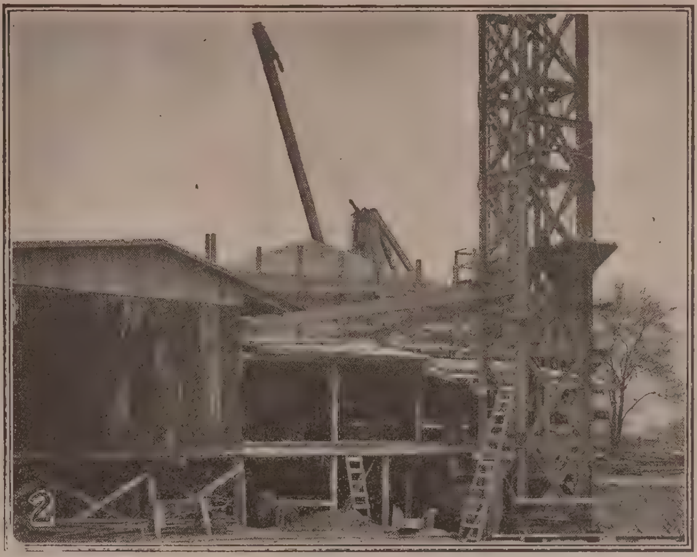
The upper photographs show the plant at the west shaft of the Hudson siphon, Catskill Aqueduct. Materials were received in barges and unloaded by derrick to a hopper over an inclined belt conveyor, which delivered them to a cross-conveyor on top of the bins at the shaft. Sand and stone were proportioned in a steel car which was drawn up an incline to the cement shed and mixer at the shaft. The plant was built by the T. A. Gillespie Company.

The lower photographs show another Catskill Aqueduct plant—that used by the American Pipe Company in concreting several miles of open-cut section near Walden, N. Y. Dry cement, sand and stone were drawn into buckets on flat cars at the crushing and proportioning plant, handled by locomotive to the mixer car at the point of work and fed to the mixer by crane. Another crane dumped the mixed concrete into the forms.

The center picture shows a mounted concrete plant on railroad work, which is supplied by wheelbarrows from piles of material on the ground. Consequently it does not require a work train in operation. A work train is out of the question in this case, as the plant is busy widening from two to four tracks a mile of the Brighton Beach rapid-transit line in Brooklyn. This work, between Prospect Park and Church Avenue, is being done by the Inter-Continental Construction Company.







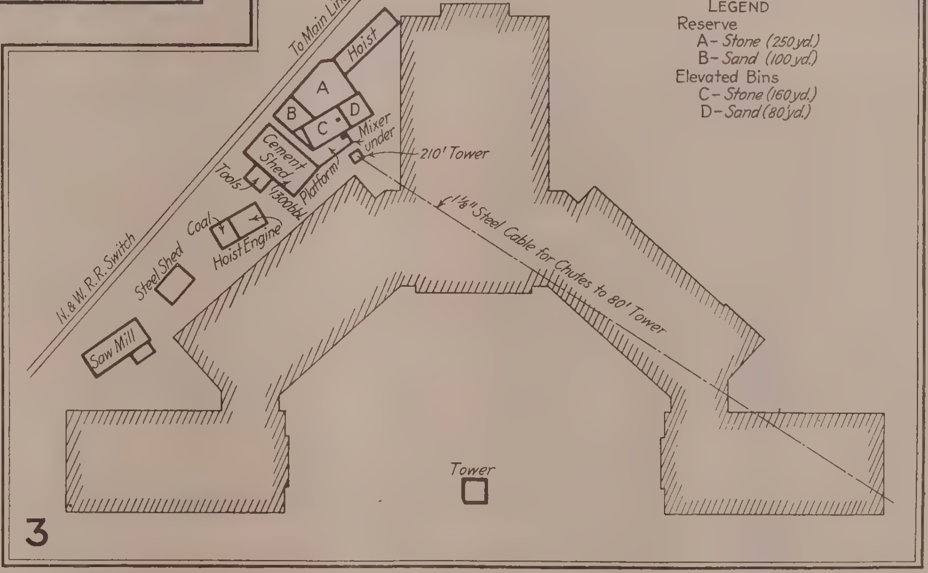
Two Plants of the Ferro-Concrete Construction Company at Cincinnati

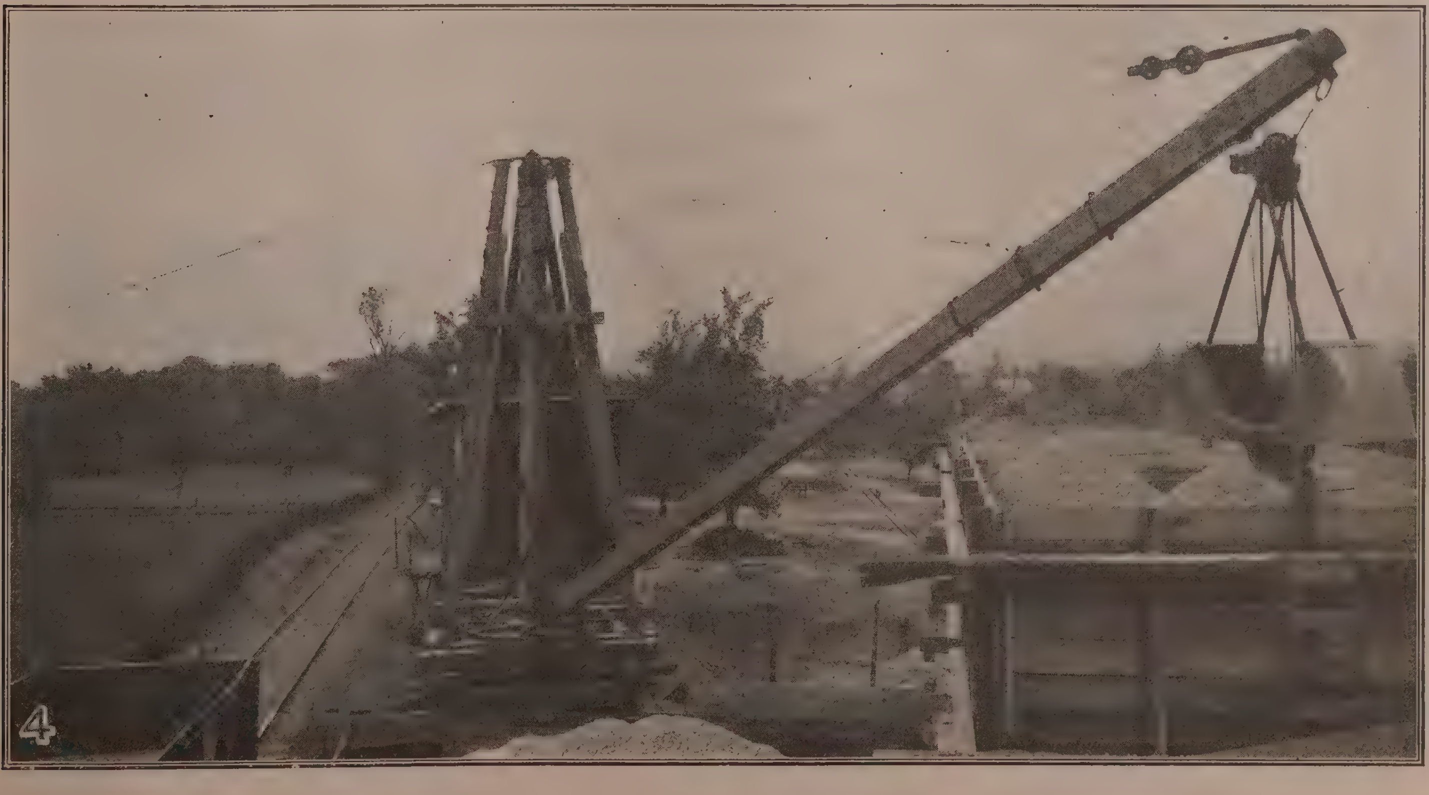
1—Endless bucket conveyor, with a capacity of 20 yd. an hour, feeds gravity storage bins of spouting plant from 200-yd. hopper under delivery track. Building for Ubiko Mining Company.

2—Gravity rollers handle cement in this plant. Dry batch is drawn into measuring car running on platform above mixer. Reinforcing and form lumber are also unloaded by rollers.

3—Layout of plant (shown in photographs 2 and 4) for concreting the East Side High School. Five main buildings (within outline of group) and small bridge (not shown) require 7700 cu. yd. of concrete, on which basis labor cost of erecting plant amounted to 41 cents a yard. Plant designed for average speed of 40 yd. an hour.

4—Hoist elevated so runner can see into car. Capacity, 300 cu. yd. a day. Space between main bins and siding taken advantage of for extra storage.





Ultra-Violet Ray Purifies Water at Cement Plant

River Water Filtered, Refrigerated and Sterilized—Supply to Employees Costs Less Than Former Distribution in Barrels

RIVER WATER is filtered, refrigerated and sterilized, then circulated through 12,000 ft. of 1-in. galvanized pipe to thirty-five sanitary drinking fountains in the plant of the Atlas Portland Cement Company at Hannibal, Mo., by a supply system recently installed at an expense less than the old system of supplying the workmen with cooled water in barrels.

The refrigerating plant consists of a 7½ x 7½-in. two-cylinder, vertical single-acting, inclosed, self-oiling, 12-ton York ammonia compressor, driven by a variable-speed 20-hp. motor and a Shipley double-pipe, flooded condenser. The cooling tank contains 1200 ft. of 1¼-in. pipe in expansion coils. Besides refrigerating the drinking water, the plant freezes 600 lb. of ice daily for use around the plant.

The 12,000 ft. of pipe through which the water is circulated is broken up into loops through which the refrigerated water is pumped. The longest of these loops contains about 5000 ft. of pipe. Most of the pipe is laid 3 ft. under the ground, with no other insulation than the clay, the piping above the ground being covered with a cork lagging.

PIPES INSULATED BY CORK LAGGING

Fifteen hundred gallons of water is circulated per hour, leaving the pump at an average temperature of 40 deg. Fahr. and returning to the cooling tank at temperatures fluctuating between 50 and 55 deg. Fahr. Thus a fairly uniform temperature is obtained at the fountains, varying between 40 and 50 deg. Fahr., depending on their location in the several loops.

The sterilization of the water is one of the unique features of the installation. The apparatus, known as an RUV sterilizer, utilizes the ultra-violet ray as produced by a special mercury-vapor lamp sending its rays into the water through a quartz tube. The new drinking water system reduced the expense and trouble connected with supplying the workmen with water and ice in barrels, at the same time giving the employees the benefit of a drinking water that is both pure and cold.

Make Compression Tests of Electric Conduits

Conduits Embedded in Floor of Railroad Building, St. Paul, Show Strength Equal to That of Concrete

By W. E. KING
Treasurer, Toltz Engineering Company, St. Paul

TESTS made to determine whether it would be safe to embed electric conduit in the compressive side of the concrete floors in the Railroad Building, St. Paul, show that the conduits tested developed ample strength as compared with the concrete displaced. By avoiding the necessity for a 3-in. cinder fill in which to embed the conduit, an estimated saving of 10 per cent in the cost of the tile arch floors was obtained.

In the Railroad Building now being constructed in St. Paul there will be an area of more than 700,000 sq. ft. of reinforced-concrete floor. The framework of the building is the usual steel-skeleton type, with steel beams extending between the columns only. The floors consist of 4-in. concrete joists, separated by 12-in. tile. The concrete above the tile, forming the "tee" of the joist construction, is 3 in. thick. The usual construction would provide for a 2-in. thickness of concrete over the top of the tile.

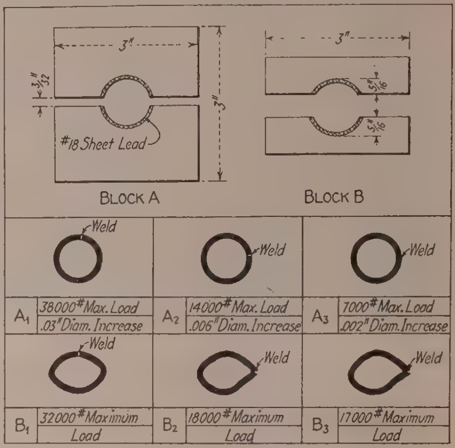
HOW ECONOMY WAS ATTAINED

This additional thickness of 1 in. was allowed in order to provide a space for the electric conduits, which are to be placed before the concrete floors are poured. This arrangement results in a considerable saving over the usual plan of placing the conduits in a 3-in. cinder fill above the top of the rough slab. In this case the cinder fill was rendered unnecessary for fastening the floor surface down, because the floor finish is to be 1¼-in. cement or "Terrazza." The use of this construction results in a saving of about 10 per cent over what the cost would be for tile arch floors with 3-in. cinder fill on top for bedding the conduit.

As this construction makes it necessary to embed the electric conduits on the compression side of the slab, the conduits as hollow tubes must resist a compressive stress of about 650 lb. per square inch, in approximately the same manner as a boiler flue.

CONDUITS TESTED IN COMPRESSION

The question was raised as to what is the safe crushing strength of such electric conduit. The writer was unable to find records of any tests having been made to determine this, so it was decided to make an accurate test. For this purpose six samples of ¾-in. "Greenfield Duct," manufactured by the Sprague Electric Company, were cut in pieces 3 in. long. Three of these pieces, A1, A2 and A3, were tested by placing them between the two halves of block *A* and subjecting them to compressive pressure in a testing machine. Block *A* consists of two pieces of 3 x 3-in. cast iron with a hole drilled through as shown in the accompanying sketch. A strip of sheet lead was inserted around the conduit in order to reproduce, as nearly as possible, the conditions of uniform pressure under which the conduit would act when embedded in the concrete. The experiment was varied in the three specimens by turning the weld in the conduit to a different point on the circumference relative to the slot between the two cast-iron blocks.



BLOCKS AND SPECIMENS USED FOR TESTS

None of these test pieces were tested to destruction, but the test was carried far enough to show that the strengh of the conduit was considerably greater than the ultimate strength of the concrete in which it was to be used, as shown in the accompanying table.

In order to duplicate the condition of a conduit coming close to the outer surface of the concrete, slab test-block *B* was prepared. It differs from block *A* only in the fact that the slot between the two halves of the block is made considerably greater. As was expected, the B specimens were distorted at a less load than the A specimens.

MEASURED DIAMETERS AND APPLIED LOADS IN ELECTRIC CONDUIT TESTS

Specimen	Weld at	Outside Diameter Original, in.	Outside Diameter After test, in.	Load applied, lb.
A1........	Top	1.042	1.072	38,000
A2........	Side	1.057	1.063	14,000
A3........	Side	1.056	1.058	7,000
B1........	Top	1.042	1.101	15,600
B2........	Side	1.056	1.128	14,400
B3........	Side	1.056	1.128	14,400

Seam opened for B2 and B3 at load of 14,400 lb. The maximum load applied to B1 was 32,000 lb.; to B2, about 18,000 lb.; and to B3, about 17,000 lb.

Attention is called to the fact that the position of the weld with reference to the unsupported part of the conduit greatly affected the strength of the conduit; that is, in the cases of specimens B2 and B3, where the weld was brought opposite the slot between the two blocks, the strength of the conduit was found to be a little more than one-half that of specimen B1, where the weld was placed at the top.

The elastic limit of the conduit is reached at a load of about 3600 lb. per square inch, and failure thereafter is at a very gradual rate. The strength of all three specimens B is above the ultimate compressive strength of 1:2:4 concrete.

Six pieces of conduit were cut 6 in. long and embedded in 6-in. cubes of mixer-run 1:2:4 gravel concrete. These cubes were tested at the age of 28 days and failed by the crushing of the concrete without damage to the conduit. The strength of the cubes averaged a little more than 2500 lb. per square inch.

No tests were made to determine whether the insertion of conduits running crosswise of a concrete beam will lessen the shear strength of the beam. This factor should be taken into consideration in case the conduits occur close to the support and in case the area cut out represents any considerable portion of the shear value of the slab or beam. Larger sizes of conduit would probably show a less compressive strength in crushing than the ¾-in. size tested.

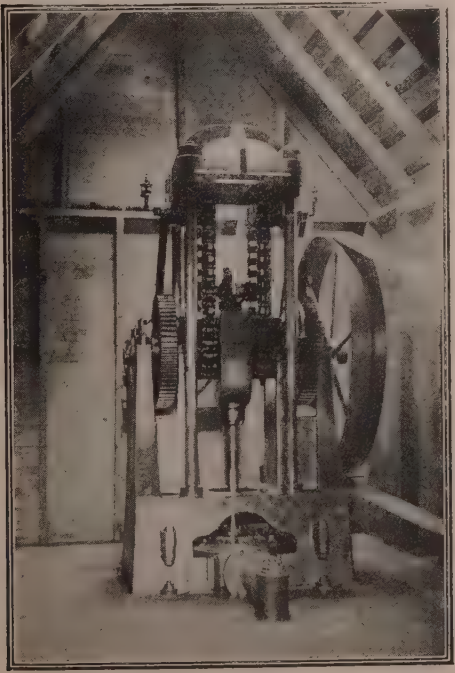
These tests were made under the direction of the writer by J. O. Meyer, chemist, and O. B. Robbins, assistant engineer, of the Great Northern Railway Company. The designs for the floor slabs were prepared by the Toltz Engineering Company, consulting engineer for the Railroad Building, under the direction of R. Budd, assistant to the president of the Great Northern Railway Company.

Kinks and Operating Costs at Small Pumping Plant

Concrete Mufflers Replace Ordinary Type, While Simple Device Supplies Warmth for Engine Room

DEEP-WELL pumps, a lighting system and commercial motors are supplied in the village of Downer's Grove, Ill., by a municipal electric plant consisting of two horizontal two-cycle 120-hp. Snow Diesel engines. To cut down the noise of the exhaust the original mufflers were replaced by large reinforced-concrete mufflers designed by H. A. Gardiner, superintendent. They have conical roofs and a steel stack projecting 3 ft. above the top. The outside diameter is 8 ft. and the height 10 ft. The structure rests on six concrete piles, because if set on a solid foundation the ground in the vicinity starts vibrating in harmony with the exhaust. The size of the mufflers was determined by the piston displacement and scavenger air volume per stroke. The exhaust enters at the bottom and on the side, where a circular brickwork makes the gases whirl about the center of the muffler. This circular motion has a tendency to pull a vacuum behind the gases. On top of the brickwork forming the first stage is a system of grate bars, and on top of these are ordinary brick in loose layers which act as a baffle to break up the noise of the exhaust. On top of this is a fine wire screen with a layer of crushed stone to further break up the report. The conical-shaped top is merely to keep out the rain. A connection to the sewer is made to drain the interior condensation.

In order to keep the concrete from getting too hot when running continuously under heavy load, a ½-in. pipe is tapped into the exhaust pipe just outside of the muffler. Water is thus carried into the muffler as steam and keeps the temperature down. Frequently an accumulation of carbon in the muffler will catch fire, but it is allowed to burn out until the concrete begins to get too hot, when water is turned on full in the small pipe to put out the fire. This process makes the muffler self-cleaning. The mufflers are so effective that the exhaust cannot be heard or any vibration of the air or ground felt when standing immediately beside them.


NEW TYPE OF PUMP IS USED

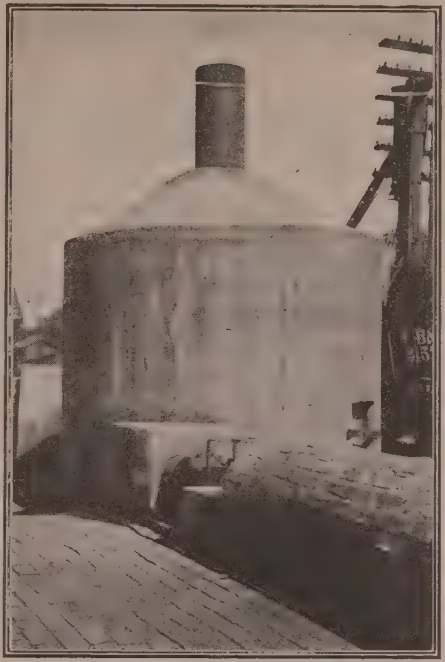
Engine Intake Makes Heating Problem

When both engines are running their intakes exhaust about 4000 cu. ft. of air per minute from the room. After the installation was made it was found to be practically impossible to keep the engine room warm enough in winter. This was ingeniously overcome by making an air intake to the room and at the same time utilizing a portion of the waste heat of the exhaust. The iron exhaust pipe on one side of the station was bricked in, leaving about a 6-in. space around the pipe and with the outer end of the brickwork open. The inner end of this brickwork opens into the floor of the engine room near the intake ports of the engine. The air is thus drawn in over the hot exhaust pipe. The advantage is twofold—the warmed air produces a better mixture for the cylinders and gives the needed warmth for the engine room.

The exhaust pipe from the other engine is carried through the oil-tank room and the whole room is used as an intake flue for the engine. Incidentally this heat in the oil-tank room keeps the oil in good shape in the coldest weather.

Water Supply Provided by Deep Wells

The village water requirements are supplied from two deep wells, and in order that the pumping could be done entirely by electrical means a special type of deep-well pump, manufactured by the Deming Company, was used. These two deep-well pumps are belt driven by 15-hp. variable-speed motors. These were the first pumps of the kind to be installed and their operation is considered very satisfactory. During peak load on the electric system the deep-well pumps are slowed down to the bare requirements of the system. They discharge into a 60,000-gal. cistern from which the water is supplied under 60-lb. pressure to the mains and standpipe by two centrifugal, two-stage, 350-gal.-per-minute pumps, driven by 20-hp. variable-speed motors, which are also slowed down during peak-load periods.


CONCRETE MUFFLER FOR DIESEL ENGINE

Scalped oil is purchased in 10,000-gal. lots from the Texas Company and stored in the 12,000-gal. tank in the station. The average fuel cost for the year 1915, placed in the tank at Downer's Grove, was 2.94 cents per gallon. The average cost of oil at the switchboard for the same period, including that used in trial runs, testing out, tuning up, etc., was 0.331 cent per kilowatt-hour. The oil consumption was found on test to be 0.50 lb. of oil per brake horsepower hour full load; 0.52 lb. of oil per brake horsepower hour three-quarters load, and 0.60 lb. of oil per brake horsepower hour one-half load, for oil having a heat value of 19,000 B.t.u. per pound. The overall efficiency of the station is above 30 per cent.

Absorbing Overhead

California's state highways are fast being completed and the overhead is therefore rapidly being absorbed. According to the July *Bulletin,* 1320 miles of road have been built at a cost of $13,746,396, with 84.32 per cent going directly into the roads. The cost of administration, technically known as "overhead," amounts to $604,926, or 4.41 per cent. In this "overhead" are included the purchasing, auditing and disbursing departments, the commission's attorney and its secretary, the engineering assistants at headquarters, the division engineers and their assistants, and the clerical force, both at headquarters and in the divisions, including salaries, expense accounts, rentals, etc. The greater part of the 15.68 per cent other than the technical "overhead" has been apportioned and charged directly where it originated. The technical "overhead" cannot be so charged until the completion of the work makes possible a proportional distribution. Figured in the gross percentage is 1.19 per cent for equipment and stores on hand, also 1.9 per cent for field and drafting work for 850 miles of highway in advance of contracts. Deducting these items leaves 12.59 per cent on an expenditure of a trifle more than two-thirds of the original $18,000,000.

Depreciation as Applied to Valuation

Normally, in Well-Maintained Railroad, No Indication of Withdrawal of Capital, and Should Not Be Deducted

By R. B. SHEPARD, JR.

Office Engineer, Valuation Department, Atlantic Coast Line Railroad, Wilmington, N. C.

THE WORK now being done by the engineering department of the Division of Valuation, Interstate Commerce Commission—namely, that of inventorying and pricing the units of physical property of the railroads and estimating the physical condition thereof—is in compliance with that section of the Valuation Act which enjoins the ascertainment of the cost of reproduction new and the cost of reproduction less depreciation. The data collected under this provision of the act are to be considered, among other "relevant facts," in fixing the final values of the properties; and, for the uses to which the federal valuation is most likely to be put, will probably be given predominant consideration as representing the present-day equivalent of capital retained in railroad service, the interest on which forms part of the cost of conducting transportation. It is the feature of capital equivalent retained in transportation service that it is desired to emphasize, and especially its bearing on the logical treatment to be accorded depreciation.

An owner of any manufacturing plant has certain obligations to the business which constitute "prior liens" on the receipts from operation and must be discharged before he can take any portion of the earnings for himself. Included in these obligations are running expenses, labor and supplies; maintenance of plant, embracing renewals of parts worn out, damaged or destroyed in service, and pecuniary liabilities arising from the use of borrowed capital. There are certain inexorable economic laws which enforce the meeting of these obligations under penalty of sure bankruptcy or loss of control of the plant. It is not necessary, though it may be advisable, to be able to show on the books of the industry at any instant that the accrued operating liabilities have been charged to operating expenses and credited to appropriate reserve accounts, though it is absolutely essential to show ability and intent to meet them when they fall due. Past performance and the condition of the property taken in conjunction with the temper of the management are sufficient indications of the policy of the company toward maintenance and the ability to fulfill its requirements.

PURPOSE OF DEPRECIATION ACCOUNTS

That depreciation is part of the maintenance expense no one denies, and the advocates of special depreciation accounts merely claim that such accounts tend to more conservative bookkeeping in that they reduce the surplus which would otherwise appear and prevent the loading of operating expenses in years of heavy renewals with charges which accrued over a period of preceding years. This, of course, is good theory, but is very much more applicable to plants of a comparatively small number of relatively large units than to a railroad, made up as it is of a vast number of units of all degrees of magnitude. In the case of a railroad the charges due to renewals and replacements are very nearly uniform from year to year; or rather are not subject to violent fluctuations. It is extremely doubtful that years of heavy renewals for any well-managed railroad can be determined from inspection of the total charges to operating expenses over any number of years, although depreciation accounts have been decidedly exceptional. The reason is that after a railroad has been in operation for a sufficient length of time to have become settled and adapted to the work to be performed the maintenance feature has become so systematized that excessive renewals do not become due in individual years; the expenditures for replacements being fairly evenly distributed from year to year producing results identical, so far as operating expenses are concerned, with those which depreciation accounts are calculated to effect. The practical result is that renewals are charged directly to operating expenses instead of indirectly through depreciation accounts which have become constant because of approximate balancing of yearly credits and debits, releasing any depreciation funds which may have been accumulated.

DEPRECIATION AND CAPITAL RETAINED IN PROPERTY

The interest of valuation engineers in the subject of depreciation is wholly in respect to its effect on capital equivalent retained in the property after construction has been completed and through the years of operation. The effort to determine the cost of reproducing the railroads is purely an endeavor to reveal the capital which is confined in them, or which it would be necessary to withdraw from other fields in order to replace them were they to cease to exist. It follows that depreciation is important from the valuation viewpoint only insofar as it affects the volume of capital held in service, or rendered unavailable for other uses. The mere fact of the existence of accrued depreciation is no more significant nor objectionable than the fact of accrued taxes, or interest, or wages, or any other of the numerous charges that continuously result from the operation of the property; nor is it any more possible to eliminate the one than the others. They are all operating liabilities to be met when due and are sustained by the same economic laws. Default in one or all is visited with the same inevitable penalties.

There is one circumstance, and one only, which could justify the reduction of the cost of reproduction new by the amount of accrued depreciation in estimating the capital equivalent of the property; namely, that an amount equal to the theoretical depreciation reserve had been withdrawn from the plant and made available for other service. Should it be developed that it has been customary in the past, or would be the practice in the event of reconstruction, to withdraw this fund when it had become no longer necessary, because of the balancing of its debits and credits, or that maintenance had been neglected to the detriment of the property, then an appropriate reduction in the statement of capital retained in service should be proper. In the former case the amount of depreciation might be regarded as a loan by the owners to the property to be repaid with interest when it could safely be withdrawn from service; in the latter there would exist an obligation on the part of the owners which would certainly have to be met in some way some day, but which, while it existed, constituted a fact of withdrawal of capital of an amount necessary completely to rehabilitate the property; this amount, in a specific instance, to be determined from consideration of relevant facts.

EARLY DEFICITS OF RAILROADS

The proposition that the amount of the accrued depreciation fund might be returned to the owners seems to be effectively refuted by the early financial histories of all railroads and of newly constructed branches of old roads. It is common knowledge that during the early years of operation few railroads or branches have made ordinary operating expenses and fewer have made fixed charges. It is obvious that any depreciation reserve, naturally built up, must have been provided from revenues earned during this early or development period, further increasing the negative margin between earnings and expenses. It is also fairly well established that a sum is to be added to the product of physical units into prices to provide for development expenses, and that this expense shall include, among other items, the deficit resulting from operation during the initial period of service.

It follows, therefore, that a depreciation fund, provided out of earnings which themselves were deficient, would have caused a further sacrifice on the part of the owners and constituted a corresponding investment in the property to be capitalized as a development expense. The real origin of the depreciation reserve can be traced still further back, or into the construction period, when it should properly have been charged to the construction account; but it certainly has not been the custom to charge construction with depreciation of rail, ties, equipment or other units to be retained in the operating service. Thus, had depreciation funds been provided, they would have been at the expense of the owners and an appropriate charge to capital account.

It seems very clear that normal depreciation in a well-maintained railroad is no indication that there has been a withdrawl of capital; and as it is with the requisite permanent capital to replace the railroads were they to cease to exist that the "reproduction" feature of the valuation has to do, it follows that there can be no subtraction of normal "accrued depreciation" to subserve its ends.

One Motor Truck Collects Manure and Waste Bedding from 1300 Horses

For the last two years one 5-ton motor truck has collected the manure and waste bedding from 1300 horses stabled throughout the city for use in the Baltimore parks. The horses are those of the various fire departments, street-cleaning and street-railway stables, contractors and other large owners of horses scattered about the city. The park department owns three 5-ton trucks—two Pierce-Arrows and one White. Though no careful detail records have been kept in connection with the operating expenses and work accomplished, William S. Manning, general superintendent of the department, states that, from a practical standpoint, it is known they are an economy. For the manure and waste-bedding work one of the Pierce-Arrows was first used exclusively, working 16 hours every day except Sunday and using two shifts of four men each.

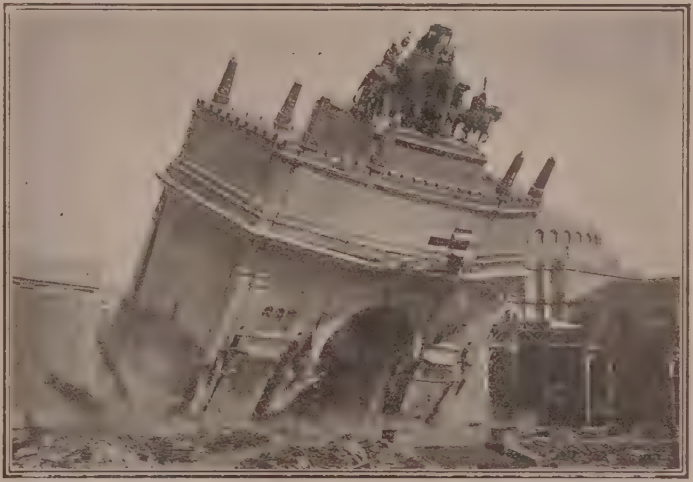
Dynamite Proves Effective in Wrecking of Panama-Pacific Exposition

Use of Explosive with But Slight Breakage Keeps Wrecking Cost Down to $250,000—Site Will Be Restored as Required by Jan. 1, 1917

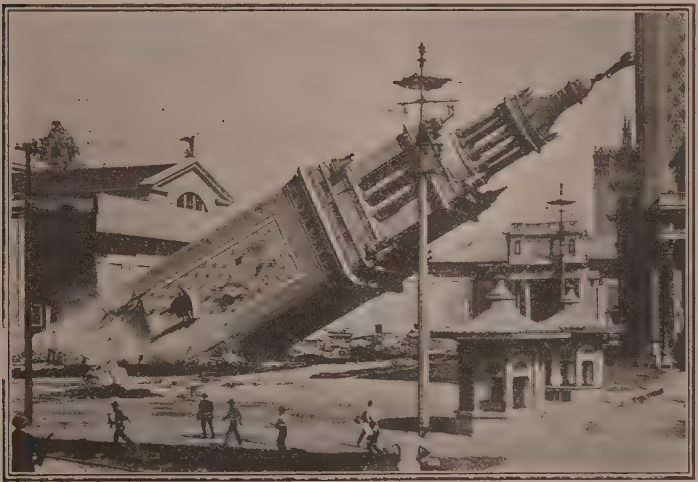
IN WRECKING the building and other physical improvements of the Panama-Pacific International Exposition and restoring the site there are the same elements of unique conditions that were so often met in the construction work. An engineering organization is in full charge of the disposal and dismantling of structures, and the work is being expedited in a manner carefully calculated to return the maximum revenue to the exposition company and at the same time comply with the agreement which calls for the complete restoration of the site by Jan. 1, 1917. The post-exposition work is divided into two independent classes—salvage operations and restoration of the grounds.

NO GOOD BIDS FOR ENTIRE JOB

Shortly after the close of the exposition it was decided to prepare an elaborate bill of sale covering the disposition in a single contract of all improvements not involved in preservation schemes. With minor exceptions no large improvements west of the Palace of Fine Arts were owned by the exposition. It was therefore decided to solicit proposals for the purchase of all physical property exclusive of real estate owned by the exposition east of the Palace of Fine Arts, except only the California Building, which is being retained for a proposed State Normal School, and the Palace of Fine Arts itself, which certain organizations purpose to preserve as a permanent art gallery, provided funds are forthcoming.



RAZING THE ARCH OF THE RISING SUN



Photos by Cardinell-Vincent Company, San Francisco

FELLING ONE OF THE ITALIAN TOWERS

This call for proposals was based on the plan that the bidder was to make a cash offer for all the improvements in question, which were to be removed under certain conditions outlined in the proposed bill of sale, with the understanding that all the salvable material was to become the property of the successful bidder. When these proposals were opened on Dec. 31, 1915, it developed that offers ranged from $4,775 to nothing and up as high as $175,000, named as the sum for which the bidder would remove the structures. These offers clearly indicated that the exposition could not expect tenders which it would be willing to accept.

To sell practically all of the improvements east of the Palace of Fine Arts, which cost upward of $11,000,000, for a sum under $5,000 would have created unfavorable comment. Furthermore, it was believed that a very substantial net sum could be realized by the exposition in doing the wrecking itself. This was borne out by an estimate prepared at this time showing a net income from salvage operations of about $200,000. Since the exposition would have to engage in a great deal of work in restoration, and an overhead organization would be required for this, it was decided that wrecking operations could be economically conducted by the exposition at the same time.

It was found, however, that it would be very desirable to contract for the removal of all small buildings, certain parts of most of the structures and a few structures in their entirety. Also it was desired to sell in place as much of the salvage as would command a price near its actual value, in order that, so far as possible, the funds of the purchasers rather than those of the exposition would be employed in the wrecking.

CLASSIFICATION OF ACCOUNTS

Having settled this policy, it was found desirable to classify all post-exposition expenditures as follows:

1. Wrecking of exposition improvements.
2. Restoration of leased lands, federal, municipal, and corporation properties; return of leased apparatus.
3. The conduct of remaining utilities.
4. General overhead expense to conduct the three classes of work named above.
5. Maintenance accounts.

Of the foregoing, the only two which have corresponding income accounts are 1 and 3.

Under the scheme proposed the Tower of Jewels was sold for $9,000 in place. This structure is being dismantled piece by piece, and the purchaser expects to save intact some 1400 tons of structural steel. It will be recalled that the tower, which had a total height of 435 ft., was supported on a two-hinged steel arch frame which extended the full height of the structure. The exposition company estimated that it would cost about $20,000 to get out the salvable material in the tower.

Among the other more important contracts were the floors and roofs—that is, the joists, girders, sheathing, flooring, roofing material and glass of the eight exhibit palaces of the main group—which were sold for $26,500; the pipe and fittings in these eight buildings and in the palace of machinery, which were sold for $25,000; the street mains, including the high and low pressure water systems, and the auxiliary water-supply system, which brought $23,000; and the Palace of Horticulture, sold for $5,000. All these contracts required the purchaser to remove the material.

In removing the structural frames of the several buildings it was first intended to pull them down section by section and bent by bent, by means of donkey engines and the necessary winches and lines. This plan was abandoned after it had been employed to some extent, and the frames are now being razed by dynamite, as it was found possible to do this with but little more loss of material. In many cases, such as in taking down the domes of the main palaces, the cost of dynamiting is less than 1 per cent of what it would have been if the structures were dismembered and dismantled by hand.

To explain the wrecking operations, it should be said that the heavy timber columns and trusses are each made up of a number of unit members separated by spacers and rigidly bolted together. This condition naturally tends to prevent shattering, so that when one of the heavy trusses falls and is broken, it is practically always found that the break is local so far as the timber is concerned. This means that the broken section of the timber can be cut out, usually leaving about 80 per cent of the piece uninjured by the fall. Of course the long tension rods are badly twisted when the trusses fall, but as their junk value is measured only in pounds it does not matter. All splintered timbers and small trash are being left where they fall in the expectation of burning them after all salvable timber is removed. After the burning there will be a second combing of the grounds for old iron from the burned timbers, and then the concrete fire walls will be wrecked, probably by dynamite, and the reinforcing rods recovered.

The usual procedure of bringing down the domes, which stand 162 ft. high and cover an area of 102 ft. square, is to cut the dome and its supporting columns entirely free from other portions of the structure and dynamite the two corners on the side toward which the dome should fall. Previous to the falling, all of the walls, studding and braces are stripped from the skeleton, leaving only the heavy timber columns which carry the weight of the dome proper. The dome itself consists of segmental timbers supported on a circular girder, which in turn rests on four trusses each carried by two columns. At each corner of the dome there are thus two columns, each consisting of four 12 x 12-in. timbers. The method of dynamiting is to bore each timber and insert a stick of dynamite about 6 ft. from the base, connecting all eight sticks by wire for simultaneous firing by battery. Bringing down the domes this way costs, for labor and powder, about $6.50 for each dome. From the dynamited domes about 60 per cent of the timber in the trusses is salvaged and about 70 per cent of the timber in the columns.

Much Material Salvable

Lumber in the larger dimensional sizes is salvable if not less than 6 ft. long, and all the structural iron, such as bolts, rods, washers, plates and nuts, is collected and sold as scrap iron. The value of the salvaged lumber varies from $5 to $20 per thousand, according to condition, size and length, the average being about $8. The iron brings about $16.25 per ton. It is notable that in the skeleton structure of the domes and supporting columns about 1 lb. of iron is salvaged with every board foot of timber, and in the skeleton columns and trusses of the structures, other than in the domes, the iron averages about ¾ lb. per board foot of timber recovered. The timber which was recovered by these operations is sold direct to individual purchasers, if they are available; if not, the same is classified and yarded for future disposition. Before lumber is yarded, all bolts, keys and plates are removed. The average cost of salvaged lumber in the yard is $5.50 per thousand; the cost of recovering steel, f.o.b. cars Exposition Grounds, is $10 per ton.

The work of restoring the site consisted of bringing the land up to specified grade, repairing and replacing streets and sidewalks, installing utility mains which had been removed, and other similar work. During this time certain general overhead and maintenance expenses go on. These consist of guards, ground lighting and other operations which are required as long as physical property remains.

In bringing the site up to grade, fills ranging up to a maximum of 11 ft. will be required in some sections. Some of this filling and that required for smaller parcels of land will be obtained from available material on the site, some from inorganic débris resulting from wrecking operations, such as sand, loam, clay, gravel and crushed rock, and the remainder from the bay by dredging operations, unless the required amount of suitable fill may be obtained by making the Exposition Grounds a free dump for excavation operations in San Francisco during 1916. Wood, paper, organic matter and other similar rubbish will not be used by the exposition for filling materials, nor will it permit the participants or their wrecking contractors to leave upon the grounds such débris as may accumulate from wrecking operations.

TYPICAL VIEW OF DOME WRECKAGE

It is the intention to leave piles which were driven for support of buildings, the idea being to cut them off 1½ ft. below the uniform ground level at which the exposition is required to leave the surface of the various blocks. The piles can be pulled for about their value, which, as far as the exposition is concerned, would result in neither profit nor loss. However, as a matter of economy, it was thought far better to leave the piles in place, which would thus become of some value to the owners of the property, without at the same time resulting in any loss to the exposition.

Some work must be done to restore certain properties belonging to public-service corporations, including pole lines, gas and water mains and railroad tracks. In general, the site will be restored to its original condition, in addition to filling in to specified grade those portions not so filled before the exposition period. Overhead-maintenance expense consists largely of the general office, guard service, fire protection, health service and sanitation, and general work about the buildings and grounds, all of which will decrease continually and will cease with the closing of operations.

WINCHES PULL SKELETON FRAMES OVER

It is expected that the wrecking expense will be approximately $250,000 and the income from salvage about $550,000. The restoration expense proper will be about $310,000; utility expense, about $95,000 (with a post-exposition income from this source of $18,000), and the overhead expense a total of $55,000, with a maintenance expense of about $200,000.

The wrecking of the exposition and the restoration of the site are being done under the direction of the division of works, of which H. D. H. Connick is director of works and A. H. Markwart assistant director of works and chief of construction. William Waters is in immediate charge of wrecking and restoration work, with L. I. Fulcher conducting field operations. C. H. Munson is in immediate charge of salvage sales.

Argues for Fuller Use of Niagara Water

True Conservation, Dr. Edward Acheson Says, Uses Inexhaustible and Preserves Exhaustible Power

ON July 13 the committee on foreign relations of the House of Representatives visited Niagara Falls in order to study the power situation. At a meeting under the auspices of the Niagara Falls Board of Trade leading men in Niagara's electrochemical plants explained to the congressmen the influence which the Niagara products had on the industries and the welfare of our country. Though most interesting, space will not allow their reprinting here. They will be found in full in the Aug. 1 number of *Metallurgical and Chemical Engineering*. Moreover, a brief summary of the products depending on hydroelectric energy appeared in this journal May 20, this year, page 679.

One of the addresses at Niagara Falls, however, was especially pertinent. It referred to a larger use of Niagara water, a proposal which has had the hearty endorsement of the Engineering Record. The speaker was Dr. Edward Acheson, the discoverer of carborundum and of artificial graphite, with its various adaptations. He spoke in part as follows:

A National Question

"My purpose in giving you statistics regarding these enterprises [carborundum and graphite production] is not with the hope of your rendering me assistance to advance my own interests, except as they may be advanced with others. I am presenting them to illustrate what may be done with Niagara Falls power in furthering the interests of our country at large. Many of the products produced in this city are absolutely essential to the successful operation of industries in cities and towns far removed from Niagara Falls.

"You may say this is all very good, but why not manufacture these materials somewhere else and preserve the Falls? This brings us to the very heart of this whole matter. Previous speakers have already answered this question better than I am prepared to do. This subject is, however, very much greater than the simple matter of supplying more power and greater facilities to the factories of Niagara Falls. It is nation-wide in importance. You, as a committee of the national congress, have a duty to perform and a great responsibility rests upon you.

AN INDUSTRIAL COMMUNITY

"While you are with us, you will not fail to be impressed with the fact that this is a novel industrial community. Niagara Falls is no longer the pleasure resort of former years. The scenic beauty of the Falls is still with us, but the true value of the Falls and this community, in so far as the country at large is concerned, consists in the vast quantities of manufactured products distributed throughout the world from our local factories, many of which were only made possible of commercial production by the generation of electricity through the diversion of water from the Niagara, and in the invisible, vibrating current of power sent out on radiating threads of copper to cities, towns and villages within a radius of 100 and more miles. Many of the factories located here on account of the power being cheaper. They have grown to large magnitude, and it is not an easy matter to move them to other localities.

"I wish I had the gift of ready language, that I might better impress you with what appears to me to be your opportunity to use your great influence and directing power in bringing about a movement which would be of incalculable benefit to our entire country, and more particularly to our posterity. Would that I might make one small remark that would cause you to depart from what, to me, seems a wicked course—the failure to properly use our great natural resources. We are at the present moment within hearing of the roar of one of the most stupendous forces in the world. Magnificent and grand from the scenic point of view it certainly is, but to me it would be much grander and more impressive were a large portion of this vast power being utilized for the present and future welfare of man.

"I consider it a veritable crime against our posterity to preserve this great natural, inexhaustible resource in its entirety, or as it now is, for reason of its scenic beauty, while we at the same time press forward to the exhaustion of the coal deposits of our country.

EXHAUSTION OF COAL SUPPLY

"We are advised our coal supply will be exhausted in another century. Certainly a goodly time, but still not great as we measure the life of nations. There is nothing visionary or fanciful about this early exhaustion of our coal supply. True, we are told of immense coal fields in Alaska, but one cannot readily imagine the factories of New York, Pennsylvania, Ohio, or, in fact, any of the states being supplied from these deposits in the frozen North. Let me impress upon you the fact that a century is not a long period. Three generations will more than cover it. An instance in my own family will well illustrate this. Among the treasures of the family is an invitation from President Washington to one of my grandfathers to dine with him, my grandfather at that time being a member of the Pennsylvania Legislature, and this was more than a century ago. Our own grandchildren may witness the practical exhaustion of our coal if no steps are taken to conserve it.

"I have here a few statistics coming from the U. S. Geological Survey: The production of anthracite coal in 1913 was 91,524,927 metric tons. Compare these figures with the production in 1820, which I find was no more than 365 tons, and this was two years after the birth of my father. Here are figures on the production of bituminous coal in the United States: In 1895 it amounted to 124,627,000 metric tons. In 1900 it had increased to 191,256,000 tons, and in 1913 it had jumped to the great figure of 478,523,000 metric tons. You will not find it difficult to see the exhaustion of the coal deposits a century hence.

"Perhaps you are not interested in the welfare of the people who will live a century hence, but I assure you that if those people find that a great natural, inexhaustible resource for power, as is the Falls of Niagara, has been preserved to them on account of its scenic beauty, while at the same time the country has been denuded of its coal supply to produce power, these faraway people will be very, very much interested in what you and all of us, of this present generation, have been doing. Unless we have already done so, they will find themselves under the necessity of diverting the water from the river for power purposes; *hence they will have neither coal*, which we will have used, *nor scenic beauty*, which we are trying to preserve.

"In closing, gentlemen, permit me to leave with you the question, *What is the true, the real conservation of our natural resources? Is it not the full and economic use of the inexhaustible for the preservation of the exhaustible?*"

Mission Bridge in Canadian Northwest Designed as Adornment to Its Location

Special Provision Made Against Abutment Sliding, While Falsework Scheme Saves Lumber—Unusual Flood Successfully Passed Before Completion

By JOHN F. GREENE
Bridge Engineer, City of Calgary, Canada

ONE OF THE FIRST bridges in the Canadian Northwest to be constructed of reinforced concrete is the Mission bridge at Calgary. A highway arch structure containing massive piers designed in simple lines to emphasize the historical mission style, with adequate provision for unbalanced thrust between the unequal arch spans, the bridge demonstrated its stability even before completion by successfully withstanding an unusual flood. Although the sidewalk forms were washed out, the concrete only a few days old showed no cracks or signs of failure.

BRIDGE SUCCESSFULLY PASSES FLOOD WATER IN JUNE, 1915, BEFORE COMPLETION

The bridge, located on a main highway running south from Calgary, Alberta, Canada, spans the Elbow River at a point about a mile and a half from the center of the city. It replaces a three-span light steel bridge which stood near the site of a ford leading to an old Catholic mission, from which the bridge derives its name.

DETERMINING CONDITIONS

The bridge floor connects with paved streets at both ends, therefore rendering it desirable to make the connection between these paved streets with a straight grade. The former bridge floor stood 4 ft. above that of the new bridge, with steep approaches at both ends. A careful investigation of conditions led to the conclusion that, although the Elbow River was subject to sudden and excessive floods, it would be feasible to adopt the ideal straight grade and still provide enough waterway under the arch openings, by excavating portions of the river bed, to pass the floods.

The city electors had appropriated sufficient money to build a bridge which would not only carry traffic but also conform to the surroundings, both natural and artificial. The bridge stands in a very desirable residential district; the banks of the river are wooded and a boulevard skirting the river affords a good view of the bridge from both the upstream and downstream sides. The Elbow River forks about 800 ft. above the bridge and flows past the site in two streams, with a wooded island between. Only during extraordinary floods is this island submerged.

With this thought in mind, in addition to the historical consideration mentioned, the bridge was laid out along its present lines. The piers and abutments were made wide and massive, to accord with the mission type, and all outside faces were left simple, with only enough projections to relieve the monotony of the dull concrete surfaces. Two small arches were used on the island because of the fact that floods of sufficient magnitude to submerge the island are of rare occurrence and because a long span would be an apparent incongruity. This was done even though it entailed an increase in the cost of about $1,200 over the estimated cost with one span over the island. A concrete baluster handrail of effective design was adopted.

GENERAL DIMENSIONS

The bridge consists of four arch spans carrying a roadway 40 ft. wide, with two cantilever sidewalks each 6 ft. wide. The arches are of the barrel type, with earth backing; one span of 86 ft., two of 34 ft. and one of 76 ft. The arches have been designed to carry 50-ton cars on two tracks, with the line of resistance inside of the middle third. Stresses were determined for a temperature drop of 100 deg. and steel provided for the tension existing under this condition.

Unusual methods were adopted to obtain increased resistance against sliding. In the abutments at both ends of the bridge, with an earth backing of 14 ft., concrete bulkheads 10 ft. high were placed. On the island ends of both of the longer spans a reinforced-concrete core wall extending 6 ft. below the base offered increased resistance against both sliding and the possibility of undermining through scour. The lack of earth backing behind these foundations and the undesirability of transmitting thrusts from the longer arch spans through the smaller made some extra provision necessary. In addition to the foregoing, battered piles were driven in the foundations at both ends of both of the longer spans.

Expansion joints were placed at the third points and haunches in both the spandrel walls and the overhanging sidewalk, and lead strips 12 in. wide were used over each joint to intercept water. Drains were provided for the earth backing at all sumps.

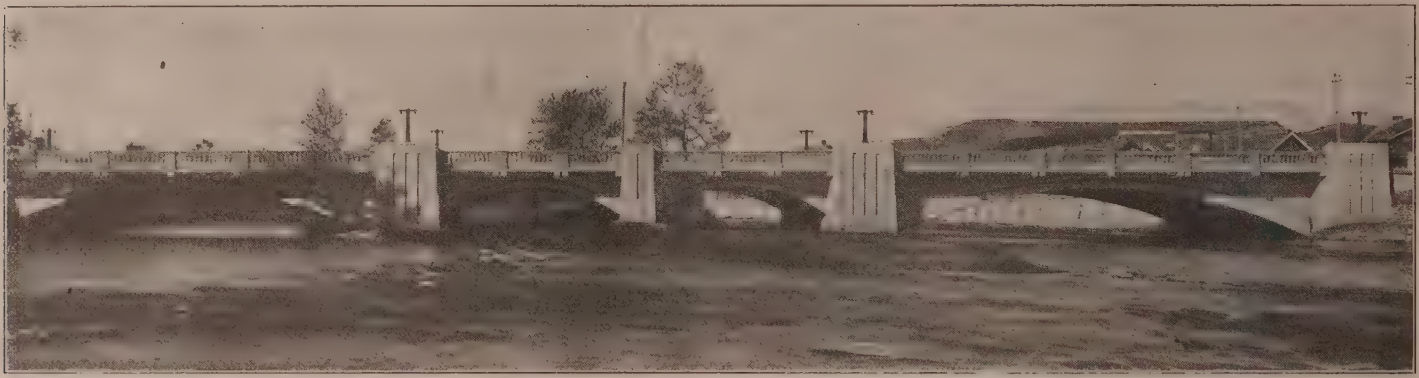
Special Falsework Details

An unusual feature of the falsework is the combination of planed boards for stringers carrying the load from bent to bent, with cross-blocks resting on the bents to give the proper arch in the panel. The lagging was nailed to longitudinal planks sprung to the curve, these planks in turn resting on the cross-blocks. The advantage of the method lay in the fact that in a region of expensive lumber the waste incident to cutting ribs to curves and the extra caps used with wedges was eliminated. The cross-blocks were odds and ends from previously used form lumber, and served the purpose of wedges for striking centers. Stringers and longitudinal planks came out intact.

On June 26, 1915, after a period of six weeks during which daily rains had been prevalent, the Elbow River experienced a severe flood. At the Mission bridge the supports holding the cantilever sidewalk forms and resting on piles were washed out. The concrete thus deprived of support was from one to three days old. A thorough examination revealed no cracks, and after two weeks the walk was loaded with no evidence of failure. With much of the waterway restricted with falsework and rubbish, the bridge passed the flood with only a slight backing up of the stream. At the crest of the flood a wooden trestle bridge which had been washed out several miles upstream was thrown against the north arch, broken to pieces and dragged through the arch opening.

The bridge was thrown open for traffic on Sept. 1, 1915, the construction work having been done by day labor, and was completed at a cost of $3.10 per square foot. The following prices for labor and material prevail in Calgary: Common labor, 30 cents an hour; carpenters, 50 cents; lumber, $22 to $25 a thousand; cement, $2.40 a barrel; sand, $1.70 a yard; gravel, $1.60 a yard; steel, $51 a ton.

The bridge was designed and constructed under the direction of George W. Craig, city engineer of Calgary, with the writer in charge of the design, assisted by Lieut. Frank Lawson, 56th Canadian Overseas Contingent. C. M. Arnold was resident engineer on construction and J. Patterson was superintendent.


EFFECTIVE USE OF MASSIVE PIERS MARKS THE DESIGN OF MISSION BRIDGE IN CANADIAN NORTHWEST

Difficult Construction in Sewer Changes

General Electric Company Makes System Conform to That of Schenectady Without Interference with Usual Activities

By PAUL G. KOCH

TO MAKE its sewerage system conform to the general plan of the system of the city of Schenectady, undertaken to prevent the pollution of the Mohawk River, the General Electric Company recently completed changes at its own expense that involved the expenditure of $100,000 and included the construction of 7 miles of sanitary sewers and a sewage pumping station. The work was carried out without interfering with the customary activities of the plant. The system serves 20,000 employees, besides providing for the usual wastes in such works. The pumping station has several interesting features, notably an ejector for removing the screenings.

Construction of Sewers

In the excavation, water was encountered 8 ft. below the surface. The material was mostly sand. This combined with the presence of pipes of all kinds, for water, gas, oils, steam and air, already installed, made the laying of the new sewers extremely difficult. Many of the lines were located beneath storage yards filled with tons of castings and lumber, and serious difficulties were encountered in avoiding interference with the network of industrial tracks about the plant, a condition in prosecuting the work being that the business of the plant should not be interfered with in any way. All sewers below ground-water level were laid with watertight joints, mostly of Jointite; and tests made after construction showed that the allowable infiltration of 1 gal. per 24 hr. per foot of sewer was more than lived up to.

The average quantity of sewage from the works is about 1,250,000 gal. per day, with maximum rates, of course, much greater than this. Previous to designing the system, measurements were taken in the old system with Bristol recording gages to determine as nearly as possible the flow of sewage and trade wastes.

The pumping-station excavation was mostly in fine sand with large quantities of water, and had to be sheeted all the way round with 3-in. splined piling, braced with 12 x 12 timbers across the opening. The bottom of the excavation was about 25 ft. below the surface of the ground, or about 17 ft. below the surrounding ground-water level. The building is about 22 x 28 ft. on inside lines and is entirely of concrete. Windows and doors are steel covered. The station is equipped with three centrifugal pumps, motor driven, and the operation is entirely automatic. The electrical equipment was designed and furnished by the General Electric Company.

One of the motors is supported on a base somewhat different from the other two. The thrust bearing is placed beneath the floor and its normal place occupied by a pulley, so that in case of emergency a gasoline engine can be attached to the shaft to operate the pump. The starting switches are so arranged that the pumps will start at different elevations of the sewage to provide for varying rates of flow and for emergency conditions should anything happen to put one or more of the pumps out of condition.

Ejectors Remove Screenings

The unique feature of the design is the installation of an ejector for removing the screenings. Trouble is usually experienced in these small pumping stations in taking care of the suspended matters removed from the sewage. In industrial plants such as this, this removal would be particularly objectionable. The sewage reaches the station in a very fresh state, solids not being appreciably broken up, and the quantity of screenings is large. Burying of this matter is not practicable and incineration is costly and otherwise objectionable. The ejector is located in the pump room, and there are 12-in. connections to a depression in the floor in front of each of the screens. When the screens become clogged the operator pumps the sewage down to a low level in the pump well, pushes the matter collected on the screens to the depression in the floor with a rake and opens the hydraulic valves to the ejector, forcing the screenings to the ejector pot. The valves on the inlet pipes are then closed, the discharge opened and the screenings forced by compressed air into the force main. Generally this operation is repeated until the screens and floor are perfectly clean.

The new layout and the pumping station were designed by James C. Harding, consulting engineer, New York City, and constructed by Brown & Lowe, contractors, of Schenectady, N. Y. Mahlon G. Milliken was resident engineer.

New Harbor Basin at Copenhagen Formed by Long Caissons Floated to Place

Reinforced-Concrete Units 162 Feet Long, with Fourteen Compartments, Are Built in a Drydock and Towed to the Site

By O. BLUME
Engineer, Harbor Department, Copenhagen, Denmark

HUGE reinforced-concrete caissons, built in a large drydock and floated to position, form the walls of the new basin being constructed at Copenhagen, Denmark, to increase the harbor facilities at that port. When completed, a harbor of 31 ft. depth of water will have been created. Many special details in the design and construction will be found unusual and of particular interest to American engineers.

GENERAL DIMENSIONS

The basin will be of rectangular shape, with three sides respectively 876 ft., 407 ft. and 202 ft. long—in all 3304 ft. of wall. The front part consists of a row of twenty-two reinforced-concrete caissons. The length of each typical caisson is about 162 ft. The caissons in the corners and one end are shorter. Each caisson is over 32 ft. high and over 16 ft. wide, with a toe on each side. Fourteen compartments are formed by cross-walls running the full height of the caisson, as shown in the drawing herewith, built with three large openings in order to save weight. Reinforcement consists of plain round rods of diameters varying from ⅜ to 15/16 in. The caissons contain about 13,900 cu. yd. of concrete and 700 tons of steel. The concrete is of 1:2:3 proportions.

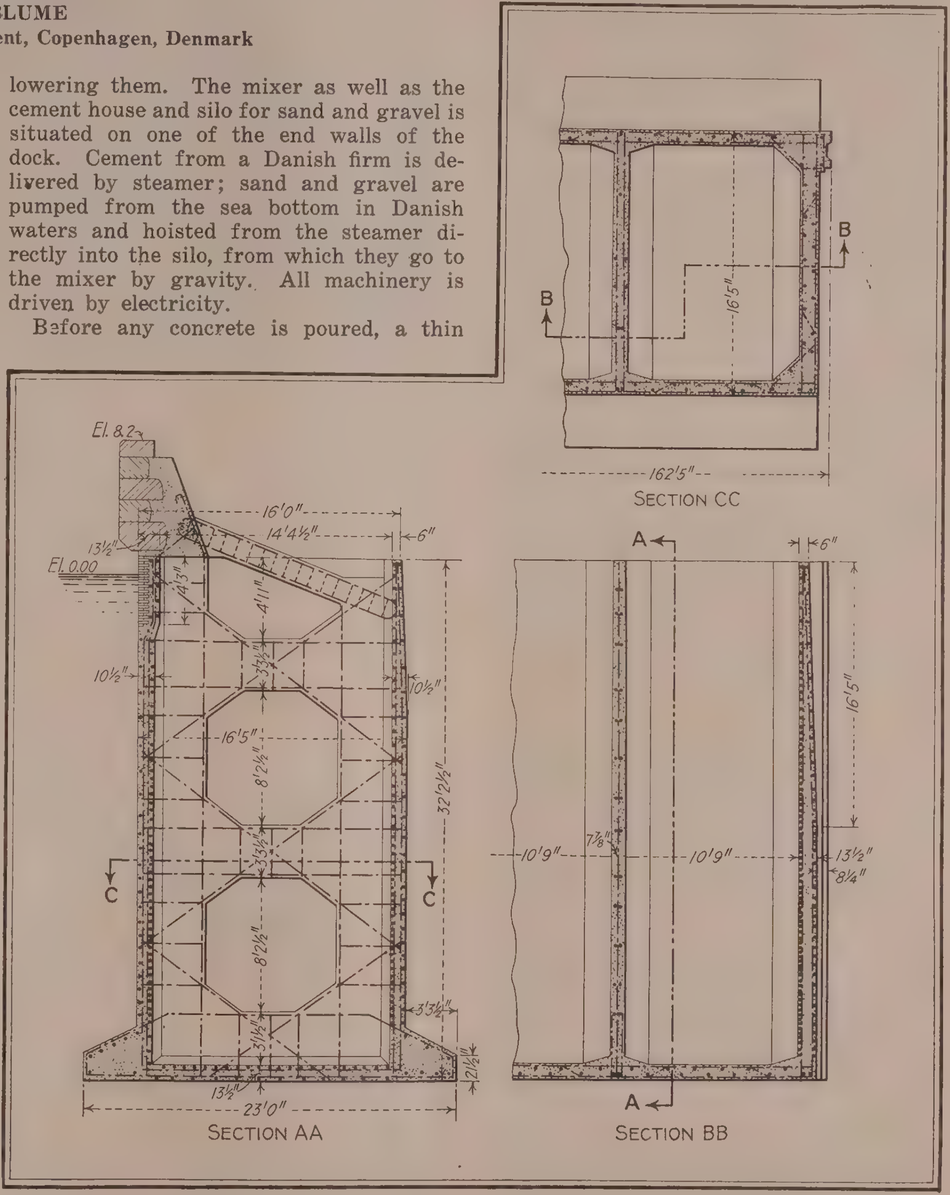
In order to construct the caissons a drydock was built. This dock has at one side a narrow tongue of land, separating part of the existing harbor from the Sound. Each of the other three sides was constructed by driving two rows of 6 x 6-in. timber, 16.4 ft. apart. These were sheathed, connected with cross-rods and the space between them filled with sand. A gate was constructed in one end. The dock was then pumped out, the bottom leveled and covered with gravel about 1 ft. thick, the upper surface of this gravel being nearly 15 ft. below near water level. Room is provided in this dock for three caissons of the usual size, the dimensions of the dock being 115 x 177 ft.

CONSTRUCTION OF CAISSONS

Forms are erected in the dock, one row along each side and two rows near the middle in such a way that each caisson is being built with forms on each side. These forms and scaffolding are built in three stories. On both the lower and the upper stories are tracks for concrete cars, which are readily brought to and from the mixer and over turntables, an elevator raising and lowering them. The mixer as well as the cement house and silo for sand and gravel is situated on one of the end walls of the dock. Cement from a Danish firm is delivered by steamer; sand and gravel are pumped from the sea bottom in Danish waters and hoisted from the steamer directly into the silo, from which they go to the mixer by gravity. All machinery is driven by electricity.

Before any concrete is poured, a thin layer of sand is laid on the gravel; on this sand is placed one layer of thick wrapper paper, on which is poured about 3 in. of concrete. The bottom sheet is placed on this and the rest of the bottom is poured. The concrete is now carried up in the usual way, pouring 3.3 ft. at a time until the caisson is 22.3 ft. high. The Smith mixer used is capable of producing 118 cu. yd. in a day. The lagging and steel for the upper 3 in. are now placed, all lagging below this removed, and about 80 tons of sand is loaded into each caisson to steady it. The scaffolding is removed, the dock is filled and the caissons, whose draft at this stage is about 14 ft., are hauled out. The dock is now pumped out, forms again erected and the next set started.

After the caissons have left the dock they are moved close to the place where they are to be sunk—about 1300 ft. from the dock—and the rest of the concreting is done from a floating plant, while sufficient ballast to steady them is put in as required. When



DETAILS OF REINFORCED-CONCRETE CAISSON USED IN COPENHAGEN HARBOR

ONE CAISSON SUNK, ANOTHER READY TO SINK INTO POSITION

APPEARANCE OF CAISSONS AFTER REMOVAL FROM THE DRYDOCK finished, the caissons are hauled into position. The sea bottom where they are to stand has previously been dug out, leveled and covered with a layer of gravel, and on this they are sunk. When ready for sinking, their bottom is only 1 ft. over sea bottom, and they are sunk by letting a floating crane, moored at each of the ends, drop a heavy load on them. The caissons that have been sunk at the time of writing stand within ½ in. of their correct position. Each end has a key fitting close to the next end key, and these keys are later filled out with grout.

The caissons, when set, are filled with sand, although 1:5:10 concrete is poured the full height and length of the caissons with a thickness behind the face wall of 3.28 ft. The dock wall proper, consisting of 1:3:5 concrete, with granite face, is now erected and the space behind the caissons filled in partly with the material previously dug out. The new basin and warehouses are erected, railroad tracks laid, and modern appurtenances pertaining to a dock installed.

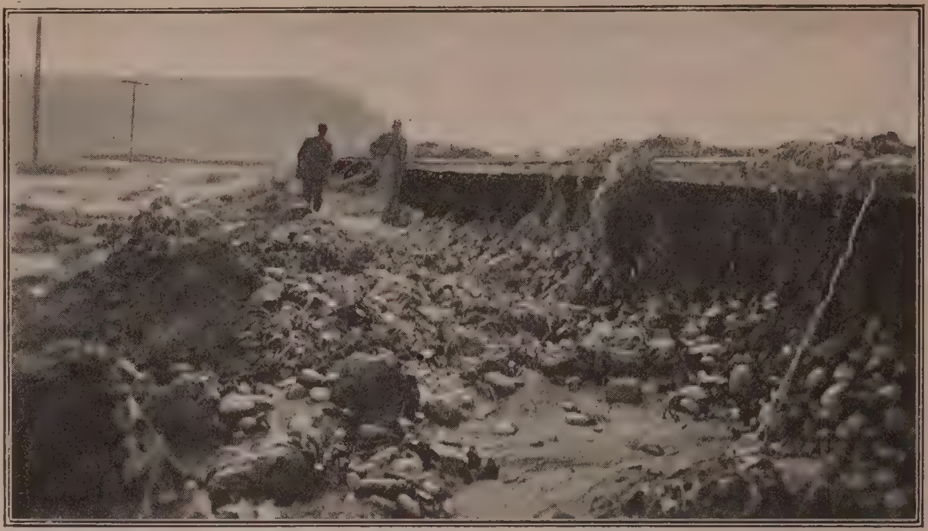
The work is being done by two Danish contracting firms, N. G. Monberg and Christiani & Nielsen, both of Copenhagen. The former is doing the digging and filling, the latter the concrete work. The contract was let by the Copenhagen Harbor Department, of which G. Lorenz is chief enginer. It was signed in May, 1915, and the work is to be completed by August, 1917. The writer, in the employ of the Harbor Department, is supervising the concrete work.

Protecting a Beach Highway from the Sea

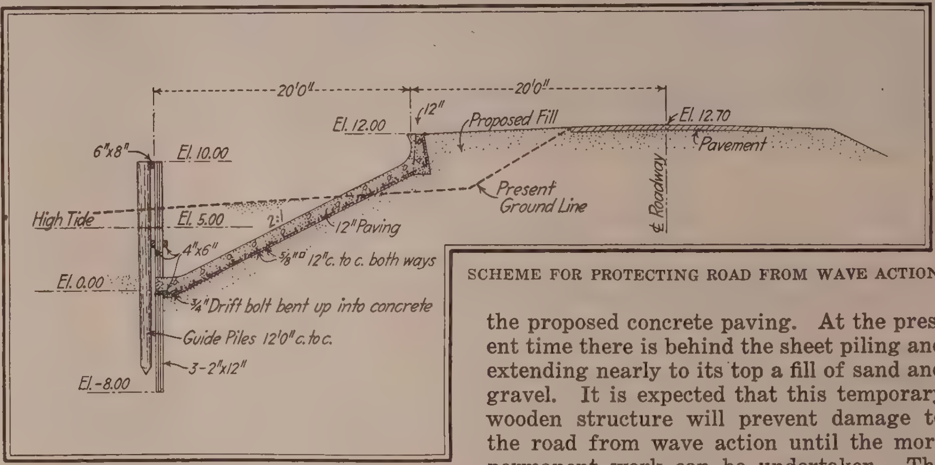
Sheet Piling Along Dike Carrying Roadway Near San Diego, California, Will Ultimately Support Toe of Concrete Paving

About 30 miles north of San Diego a natural dike parallels the shore just above the high-tide line, and has withstood the winter storms since the earliest records of local conditions. The main highway from San Diego to Los Angeles was laid out on top of this dike because of its reputation for permanence and because the best alternative route would have been considerably longer and construction would have cost about $100,000 more, exclusive of right-of-way. Furthermore, it was estimated that protection of the dike along the beach, in case it became necessary, would cost only about $50,000.

Early in 1915, for the first time, a series of heavy storms began to cut away the dike. About $1,500 was spent in protecting three-quarters of a mile of its length with bags of sand, but in spite of all that could be done the road foundation was seriously damaged in places. An accompanying illustration shows how severe was the cutting action on the land side of the dike. Plans were immediately prepared for protecting the roadway from further damage of this sort, and the first stage of the protection work has been completed.



STORM DAMAGE ON THE LAND SIDE OF THE DIKE



SCHEME FOR PROTECTING ROAD FROM WAVE ACTION

The design of the structure for protecting the roadway shown in the drawing is that which it is intended to use ultimately. The present protection consists of the triple-lap sheet piling driven along the line of the toe of the proposed concrete paving, the idea being that when the concrete is to be put in the sheet piling will be cut off and the toe of the paved slope supported upon it. This plan of doing the work in two stages was adopted because of the limited funds now available for highway work.

The triple-lap sheet piling is made up of three 2 x 12-in. planks, 18 ft. long, and is driven to a depth of 8 ft. below the toe of the proposed concrete paving. At the present time there is behind the sheet piling and extending nearly to its top a fill of sand and gravel. It is expected that this temporary wooden structure will prevent damage to the road from wave action until the more permanent work can be undertaken. The 2700 ft. of completed concrete work and fill is estimated to cost about $50,000.

The recent work, as well as the original construction of the highway, was under the supervision of Austin B. Fletcher, chief engineer, California Highway Commission.

THIS DIKE AFFORDED THE ONLY PRACTICABLE HIGHWAY ROUTE

Template Should Be Used to Shape Crown in Resurfacing Old Macadam

In resurfacing old macadam with Topeka specification or other bituminous surfaces of similar type it is best to shape the crown by using a template, according to a statement made by J. H. Huber, resident engineer of the New York State Highway Commission, in a paper presented at Good Roads Week at Cornell University. This can be done by spiking down side forms of timber at least 6 in. in width, and of the necessary thickness. Holes should be bored to take an ordinary boat spike fitted with a large washer. On these side forms a wooden template should be run. This is not for screeding purposes, but merely to aid in spreading and raking the material for depth and crown, which not only insures a better crown for every foot of the highway, but also eliminates the wavy appearance so often seen in this type.

Literature

For the Civil Engineer and Contractor

New Publications

Structural Timber Handbook on Pacific Coast Woods. By O. P. M. Goss, assisted by Carl Heinmiller. Flexible leather, 5 x 8 in.; 289 pages; illustrated. Seattle, Wash., West Coast Lumbermen's Association. $1.

Spirit Leveling in West Virginia, 1896 to 1915. By R. B. Marshall, chief geographer. Bulletin 632, U. S. Geological Survey. Paper, 6 x 9 in.; 168 pages; illustrated. Washington, Government Printing Office.

Geology and Ground Waters of Northwestern Arkansas. By L. W. Stevenson and A. F. Crider, with discussion by R. B. Dole. Water Supply Paper No. 399, U. S. Geological Survey. Paper, 6 x 9 in.; 309 pages; illustrated. Washington, Government Printing Office.

Waterworks Handbook. Compiled by Alfred Douglas Flinn, deputy chief engineer, Board of Water Supply, New York City; Robert Spurr Weston, professor of public health engineering, Massachusetts Institute of Technology, and Clinton Lathrop Bogert, assistant engineer, Board of Water Supply, New York City. Flexible cloth, 6 x 9 in.; 824 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $6 net.

Handbook for Highway Engineers. Part 1, Principles of Design; Part 2, Practice of Design and Construction. By Wilson G. Harger, first assistant engineer, and Edmund A. Bonney, supervising engineer, New York State Department of Highways. Second edition, entirely revised and enlarged. Flexible leather, 4 x 7 in.; 609 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

Strength of Webs of I-Beams and Girders. By H. F. Moore and W. M. Wilson. Bulletin 86, Engineering Experiment Station, University of Illinois. Paper, 6 x 9 in.; 50 pages; illustrated. Urbana, Ill., Engineering Experiment Station, University of Illinois.

Railway Expansion in Latin America. By Frederic M. Halsey, statistician, James H. Oliphant & Company, New York City. Stiff paper, 5 x 7 in.; 170 pages; illustrated. New York, James H. Oliphant & Company.

Heavy Timber Mill Construction Buildings. By C. E. Paul, construction engineer, Chicago. Paper, 6 x 9 in.; 66 pages; illustrated. Bulletin 2. Chicago, National Lumber Manufacturers' Association, Engineering Bureau.

Issued as a special edition for members of the National Fire Protection Association. Gives clear description of timber-mill construction, distinguishes it from the "slow-burning" type and covers in detail the design of walls, floors, columns and roof. Fire protection methods are discussed, and comparative costs of mill construction given. A short chapter is devoted to the standard mill construction recommended by the Associated Mutual Fire Insurance Companies of New England. Formulas and tables to aid in design are given in complete detail in the last 15 pages. Engineers will find in this booklet much valuable information, covering all phases of the subject of timber mill buildings, with special reference to fire-resistive construction.

Books Reviewed

Theory and Practice of Modern Framed Structures

Authors, the late J. B. Johnson, C.E.; C. W. Bryan, C.E., chief engineer of the American Bridge Company, and F. E. Turneaure, C.E., dean of the College of Mechanics and Engineering, University of Wisconsin. Ninth edition, rewritten by F. E. Turneaure and W. S. Kinne, associate professor of structural engineering, University of Wisconsin. Cloth, 6 x 9 in.; 486 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

Reviewed by F. H. Constant

Professor of Civil Engineering, Princeton University, Princeton, N. J.

Although the present volume is called the ninth edition, it is in reality the third and last of the new series which constitutes the complete rewriting of "Modern Framed Structures," first published in 1893. The first two volumes, pertaining to stresses in simple and indeterminate structures, issued several years ago, are well known to the engineering public. The present volume covers design and replaces Part II of the original large book. It bears, however, no resemblance to the earlier work. Many of the topics treated there, relating especially to building construction, elevated tanks, swingbridges and trestles, are omitted. One misses, likewise, the pleasing chapter on æsthetic bridge design. On the other hand, it comes up to all expectations in the thoroughness and modernness of its treatment of the detailed analysis of bridge design. In this field it presents much new material and methods based upon present-day accurate knowledge of stress distribution throughout all parts of a structure.

This is noticeably so in regard to secondary stresses, in which field the authors have themselves made important experimental and analytical investigations. While it is generally permissible to neglect the calculation of secondary stresses in ordinary designing, some knowledge of how they act, and of their relative magnitudes and importance in various types of structures, is essential if they are to be kept within reasonable limits. Subconsciously they should be present in the mind of the designer as he works with the primary stresses. In large and important structures they must, of course, be separately calculated. This attention to secondary stress strikes a new note in bridge design and to a certain extent forms a background for the present work.

The book contains 486 pages. The first half deals with fundamental principles. Chapter 1 gives a brief discussion of styles of structures and determining conditions. Chapter 2 discusses working stresses, the effects of impact, vibration and repetition, alternating stresses and tension members. Chapter 3 gives the fundamental principles of column action and reviews the various working formulas. The theory of the eccentrically loaded ideal column is developed and the strength of the ordinary column is related thereto by the selection, from column tests, of an equivalent eccentricity (or eccentric ratio) to cover the effect of imperfections in the column, or imperfect centering. The extreme fiber stresses, the effect of secondary stresses on the bending strength, and shear in columns are readily deduced therefrom. The design of latticing and tie plates follows from the discussion of the shear.

Chapter 4 covers combined direct and bending stresses and secondary stresses. The latter include bending stresses in the plane of the main truss due to rigidity of the joints, stresses in members of a transverse frame due to deflection of floor beams, stresses in a horizontal frame, especially in floor beams and their connections, due to the longitudinal deformation of chords, and variation of axial stress in different elements of a member. Diagrammatic sketches clearly show (by shaded areas) the nature and percentage of the secondary stresses in all members of the common types of bridge trusses. From these the designer is enabled to draw general conclusions and is guided in the choice of design.

Chapter 5 is on riveted joints and includes the principles of stress transmission, friction of joints, eccentric connections and the reduction of section by rivet holes. Chapter 6 contains a very adequate treatment of the plate girder. The moment-of-inertia method for flange areas and rivet spacing is given and compared with the usual approximate formulas. Thirty-five pages are devoted to the detailed numerical designs of 70-ft. deck and through girders.

Chapter 7 is mainly descriptive of the general features of truss design. In the remaining four chapters the principles of design discussed in the preceding chapters are illustrated by detailed designs of a pin-connected railway bridge (Chapter 8), a riveted railway bridge (Chapter 9), a riveted highway bridge (Chapter 10), and a steel roof truss and building frame (Chapter 11). In the last chapter special attention is given to the design of beam purlins where the plane of bending does not correspond with a principal axis of the section. The theory of unsymmetrical bending is worked out at length in an interesting manner in Appendix C by the aid of the "S" (or section-modulus) polygons.

The General Specifications for Steel Railway Bridges, adopted by the American Railway Engineering Association, 1910, are reprinted in Appendix A. Several tables of the most frequently used standards follow in Appendix B.

The book is intended, primarily, as a text book on bridge design. It is clearly written and abundantly illustrated by completely worked out numerical examples. At the same time the original treatment of many parts of the work and the practical introduction of the results of recent tests and researches will give the book an interest and value to the older engineers. The book contains many text drawings and eight folding plates. The typographical work is excellent.

Mechanical Engineer's Handbook

Based on the Hütte handbook prepared by a staff of specialists, Lionel S. Marks, professor of mechanical engineering, Harvard University and Massachusetts Institute of Technology, editor-in-chief. Limp leather, 4½ x 7¼ in.; 1836 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

Although this handbook is based upon the well-known German standard work by Hütte, in only a few of the more theoretical sections is the original text followed at all closely. The greater part of the book, especially that dealing with engineering practice, is wholly new, and is contributed by specialists of this country, who cover their particular fields in contributions to each of the fifteen main sections into which the book is divided. This most satisfactory procedure for developing a modern and authoritative handbook is similar to that adapted by Professor Merriman in preparing the American Civil Engineer's Pocket Book. The new book gives every evidence of a most comprehensive and satisfactory treatment of the whole field of mechanical engineering.

No attempt to give in detail the nature of the treatment of the many fields covered can be made in this short review. It is sufficient to state that among the contributions in fields which directly interest civil engineers will be found the names of Prof. W. K. Hatt of Purdue University, on strength of materials, including the theory of reinforced-concrete design; Sanford E. Thompson, on materials of engineering, treating the subject of cement, mortar and concrete; Prof. Hugo Diemer of Pennsylvania State College, on cost and other factory accounts; H. A. Gardner of the Institute of Industrial Research, Washington, on paints and protective coatings; Richard Moldenke, consulting metallurgist, on iron and steel castings; Prof. W. G. Raymond of the State University of Iowa, on surveying; Prof. E. Schmidt of the University of Illinois, on railway engineering; Prof. E. W. Schoder of Cornell University, on hydraulics, and Dr. Hermann von Schrenk, consulting timber engineer, on wood.

It is evident from the foregoing names and topics that the book not only covers mechanical engineering subjects, but contains much of interest to the civil engineer. It undoubtedly presents the most comprehensive and authoritative data on all subjects connected with the work of mechanical engineering in condensed, tabular form, put in excellent shape typographically, and with especially careful attention to details, such as references and listed notation in mathematical discussions. A very comprehensive index occupies 56 pages.

Not only is this new book indispensable to mechanical engineers, but all civil engineers who meet mechanical problems in their work will find it to be most essential as part of their working library.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Examinations for Corps of Engineers Not Severe

SIR: The law passed by Congress in July, 1911, requires as a prerequisite to taking the examination for a commission in the Corps of Engineers of the Army that a civilian candidate must be eligible for appointment as junior engineer in the Engineer Department at Large in accordance with civil-service regulations, and this requires that he qualify through the civil-service examinations for appointment as junior engineer in the Engineer Department at Large. These examinations are under the United States Civil Service Commission. The questions are prepared, the examination held and the marks given by examiners under the sole jurisdiction of the commission.

An examination of this character was held in April, 1916, and the fact that it was not unduly hard has been certified to recently by the dean of one of the most noted engineering colleges in this country. The questions were submitted to him, and he stated that they were very fair, and he could not understand why a graduate of any of our technical schools should not be able to pass.

The facts are, however, that more than 125 candidates took this examination, and of these only about 60 per cent received the passing mark of 70. Omitting the cases where schools were represented by only one or two candidates, there remain ninety-eight candidates distributed among sixteen of our most noted technical schools, each of which was represented by no less than four candidates.

Of the candidates who had graduated from these sixteen schools, only 63 per cent passed this easy examination, and from this it would appear evident either that the education now given by our technical schools is not thorough or else that the candidates who tried this examination were not really representative graduates.

The facts above stated have a bearing upon some articles that have appeared in the recent past in our technical journals to the effect that the examinations for commissions in the Corps of Engineers of the Army were unduly severe and that they were purposely made so because the officials of that corps did not look with favor upon admitting civilians into the corps.

This is not true, for the Chief of Engineers for a number of years has been making special efforts to obtain a supply of officers for the Corps of Engineers from the graduates of our good technical schools. At his request a special civil-service examination was held last August in order to furnish an opportunity to graduates of that year to become eligible for the examination for second lieutenant to be held in the following October, and at his request special arrangements were made by the Civil Service Commission this spring enabling those about to graduate to take the civil-service examination so that they might become eligible to take the examination for commission in the Corps of Engineers to be held throughout the country on Aug. 21-25, 1916.

The results of the civil-service examination noted above would appear to indicate that the reason why a greater percentage of civilian candidates have not heretofore passed the examination for commissions in the Corps of Engineers has not been due to the severity of these examinations.

W. M. BLACK,
Chief of Engineers, U. S. Army.
Washington.

Larceny

SIR: The editorial entitled "Larceny" in your issue of July 22, 1916, is very pertinent in calling attention to a regrettable evil in the practice of engineers; but you fail to indicate the obvious remedy. The patent laws of this country are premised on the principle that the laborer is worthy of his hire, and in return for the public disclosure of his invention the patentee is granted a monopoly for the limited term of 17 years, provided the inventor is so fortunate as to be able to meet the expense of necessary litigation.

Inspection of your issue for July 22 discloses that approximately one-half of the advertising space (exclusive of the Searchlight Section) is devoted to patented devices and processes. From this it is inferred that civil engineers make extended use of such patented devices and processes. In fact it is common knowledge that civil engineers are quite willing to use patented H-beams in building construction, to use patented deformed bars in bridges, to use patented machinery in hydraulic constructions. The use of such patented devices can be justified only on the ground that the engineer specifying them believes their use will insure a better structure for the same money or an equally good structure for less money.

How different is the attitude of the civil engineer when it comes to a Bone patented retaining wall, a Luten patented bridge or a Cameron patented sewage-disposal plant. Use of any of these secures a better result for less money, but the civil engineer is opposed to such patents. Why is the opposition? Is it that the engineer who "on ethical grounds is opposed to patents" is willing to pay royalty only when that royalty is concealed from his client by reason of being included in the purchase price of a manufactured article? Is it that the civil engineer makes mobility the criterion of patentability? Or, as pointed out by you, is it that civil engineers are opposed only to patents on such new and useful improvements as can be easily pirated?

Indianapolis. DANIEL B. LUTEN.

Engineers and the New Nationalism

SIR: The article by Frances A. Kellor entitled "Engineers and the New Nationalism," in your issue of July 1, page 12, has been noted with considerable interest. With most of this article I generously concur. Personally, however, I do not share the general feeling of most American engineers that I have talked with on the question as to the desirability of engineers' aggressiveness in militarist developments. I should like to see engineers devote considerable energy to the study and the elimination of the causes which have made militarism a necessity.

Is there not a great opportunity for American engineers to lead the way in a movement toward the elimination of the economic causes of war? Is not the American engineer better qualified to study and to broadly analyze the whole question which underlies the economic causes of conflict? It seems to me that although this problem has usually been left to political economists and to the ministry, it could be more constructively treated by men whose mental processes have been developed by engineering training and practice and who are peculiarly trained to plan and co-ordinate the intricate problems of organization.

Miss Kellor's deduction that the "Americanization pioneer in the new community is the engineer," although perhaps overstating the case somewhat, yet undoubtedly is the trend of the time, and I hope that the young native-born engineer of the future will do his share in preserving American traditions and will help to teach them to the strangers that come within our borders. May our technical papers lay emphasis upon the fact that American traditions demand the development of the individual and not encourage, but positively discourage, the development of a top-heavy, unwieldy and dangerous octopus—Militarism.

D. ROBERT YARNALL.
Philadelphia, Pa.

Brick and Tile Production in 1815

The value of the brick and tile products of the United States in 1915, according to a bulletin of the U. S. Geological Survey, was nearly $125,800,000—a decrease of 3 per cent compared with the previous year. The product that showed the greatest decline was sewer pipe, although common brick and terra cotta fell slightly.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Field-Office Accounting: Finding Costs

By **BENJAMIN L. LATHROP**
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

ASSUMING that the monthly estimates rendered by the engineer for the owner are at least approximately correct, the following method may be followed for finding the unit costs for a given month. An equitable proportion of the local office expense, compensation insurance, charges for repairs and other incidentals, is added to the labor and material cost for the item for the month and divided by the yardage allowed for that class of work on the estimate. The quotient represents the approximate unit cost, excluding interest on the investment in equipment, general office expense and other overhead charges with which the local agent or manager cannot be expected to be familiar. These additional charges should be taken into consideration by the contractor in connection with the reports furnished from the job.

Excavation, 19408.9 cu. yds. @ .59	$11451.25
18" sewer pipe in place, 462 ft., @ .80	369.60
Concrete masonry, 1307.5 cu. yds., @ 8.47	11074.53
	$22895.38
Less previous payments, etc., etc.	

Such an approximate unit cost obtained each month will probably turn out to have no permanent value, though it may serve to indicate the fact if any foremen in the organization have not produced results proportionate to the expense involved. The unit cost from month to month will fluctuate considerably, as it will be affected by weather conditions, variations in the character of material excavated, variations in the relation between volume of concrete placed to area of finished surface, and other factors which enter into the actual production. Moreover, some engineers have a way of making up their monthly estimates anywhere from the 25th of the month to the 5th of the following month, as the result of which a very fat month of about 40 days may be followed by a very lean one of about 20 days.

The attempt to figure monthly unit costs does help to keep a line on the situation, however, and the average taken over a period of three or four months will prove fairly accurate. At the completion of the job, with the final estimate taken, a correct tabulation can be made. Assuming that a final estimate has been compiled giving the quantities in the small table shown herewith, the total and unit cost and profit may be summarized as outlined in the large table. In actual practice there would be many more divisions of the work, and the final summary would not be so simple as that shown herewith for the purpose of illustration.

SUMMARY OF COST OF WORK AT DOANE'S CROSSING.

		Concrete	Sewer	Excavation
Cement, 1587 bbl. at $1.59	$2523.33	....	....	....
Less 5760 sacks redeemed	576.00	....	....	....
		1947.33	....	....
Crushed stone, 1085.75 tons at 0.70	....	760.03	....	....
Sand and gravel, as per invoices	....	666.54	....	....
Oil and fuel, as per invoices	....	54.32	....	337.86
Miscellaneous items, including freight	....	1173.33	....	1011.12
Lumber for forms	....	682.45	....	....
Cost of bond	....	65.00	....	50.00
Compensation and liability insurance	....	335.38	....	570.49
18-in. vitrified pipe, 462 ft., including bends and tees	....	....	204.54	....
Explosives as per invoices	....	....	....	255.00
Labor, as per payrolls	....	4003.77	109.69	5704.90
		$9688.15	$314.23	$7929.37

1307.5 cu. yd. concrete totalling 9688.15 figures cost per cubic yard	$7.41
462 ft. sewer, totalling 314.23, figures cost per foot	0.68 plus
19408.9 cu. yd. excavation totalling 7929.37, figures cost per cubic yard	0.41

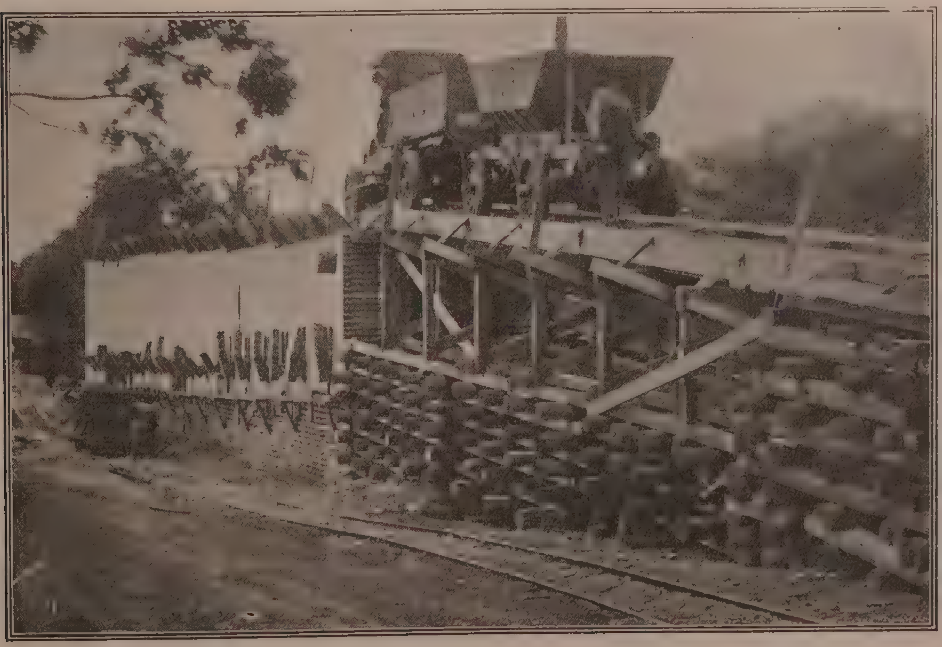
Quantities	Unit Cost	Contract Price	Unit Profit	Total Cost	Contract Total	Total Profit
1307.5 concrete	7.41	8.47	1.06	9688.15	11074.53	1386.38
462 sewer	0.68	0.80	0.12	314.23	369.60	55.37
19408.09 excavation	0.41	0.59	0.18	7929.37	11451.25	3521.88
				$17931.75	$22895.38	$4963.63
					17931.75	
					$4963.63	

Of course, the figures assumed are used only to outline the methods. Minor discrepancies in extension result from the unit costs having been carried out only to the nearest cent. If the reader objects to the profit shown of more than 25 per cent, he should remember that although we cannot make money at this rate on a real contract, it is pleasant to visualize such possibilities on paper.

Transferring Stone from Trucks to Train Simplifies Road Work

THE COMBINATION of motor-truck transportation to a convenient point and distribution along the work from this point by industrial train is coming into favor with contractors for concrete roads. On the job illustrated in the photograph a narrow road with a street-car line at one side was being paved with concrete 16 ft. wide. The materials for this concrete, dumped on the subgrade in advance of the mixer, could scarcely be piled so as to avoid blocking the road. This feature, aside from the damage that might be done by trucking over the subgrade, made it necessary to provide some other way for keeping the mixer supplied with cement. The industrial railway, with fifteen 1½-yd. cars and a 13-ton locomotive, was therefore installed to handle all the concrete materials. This outfit could make a 1½-mile round trip in 20 minutes, including the time consumed in dumping the material.

The trucks which deliver the material to the transfer bins hold 2 yd., and each trailer holds 4 yd. All the units are bottom dump. The road, 4½ miles long, is being built from Birmingham, Ala., to Pontiac by R. D. Baker.



TRUCKS TAKE STONE TO BINS, INDUSTRIAL TRAIN DISTRIBUTES IT ALONG ROAD

Leads Bolted to Cantilevered Floor Steel to Drive Falsework

By T. V. GARNES
Rome, Ga.

WITH A LIGHT derrick car and swinging leads attached to floor stringers cantilevered out from the last bent of falsework erected, the writer drove the piling for and erected successfully and economically two 150-ft. fixed spans and a 264-ft. swingspan at Macon, Ga. The bridge, which is shown in the photograph, crosses the Ocmulgee River and was erected for the Macon, Dublin & Savannah Railway.

After the first bent of falsework was erected and the first panel of the floor system placed, the second panel of stringers was set, overhanging the full panel length of 24 ft. To the ends of these stringers were clamped two 8 x 8-in. timbers to which the leads could be bolted at the location of each pile. The leads were carried by the hammer in moving, and it was only a matter of a few moments after one pile was down to unbolt them and set them in the next position. A runner line was used to handle the piles. To remove the entire rig after a bent of falsework was driven, the leads were unbolted, the four bolts securing the cross-timbers were loosened and slipped off the ends of the stringers, the car was run ashore and the driving rig set down. The bents could then be capped and the next panel of floor system erected.

It was necessary to maintain a 35-ft. channel in the river for small boats. In order to do this two panels of the floor system were allowed to overhang at once, being guyed back, as shown in the photograph, with two sets of falls. The bent of piles at the end of this cantilevered section was then driven and capped, and sufficient long timbers were placed on it and on the last bent driven, two panels behind, to carry the intermediate panel point.

TWO PANELS OF FLOOR SYSTEM SET IN ADVANCE OF DRIVING FALSEWORK

30-Foot Horizontal Test Boring Made with Hand-Hammer Drill

By H. L. HICKS
Great Neck, N. Y.

THE Portland Contracting Company of Pottsville, Pa., in driving a tunnel for the Harleigh-Brookwood Coal Co., at its Stanton Colliery was approaching some old workings. The exact depth at which these would be encountered was not known, and to make sure that they did not contain water it was decided to drill a test hole.

No prospecting drill was available, and as time was of the utmost importance, to avoid the delay of calling in a drilling contractor they determined to try drilling a deep hole with a jackhamer.

The hole was started with four pieces of steel, 3, 6, 9 and 12 ft. long, sharpened to a 2-in. gage. After drilling ahead 12 ft. a bit was welded into a 2-ft. length of 1-in. pipe and a shank into another similar length. With some extra-heavy couplings these were connected to a 10-ft. length of the same size pipe and drilling was resumed.

It was expected that the old workings would be reached at any time after drilling to this depth, but it was necessary to add successive 2-ft. lengths of pipe, resharpening the bit each time, until a 30-ft. steel was being rotated by the little 40-lb. jackhamer.

When the drill ran into the old workings at this depth the drill bit was 1⅝ in. in diameter. The extra-heavy pipe couplings were beginning to bind in the hole, but the operator predicted that he could "go a few feet more if he had to."

This hole was drilled through hard slate formation on about a 6-deg. pitch.

Forms Knocked Down by Cutting Wires That Hold T-Posts

EACH of the posts under the arch form shown in the photograph is made of two 1 x 4-in. plank, one placed with its edge to the side of the other, giving a T-section, and wrapped with wire at sufficiently close intervals to make them act as one member. As the contractor states that the nearest commercial size of post that can be depended on to carry the same load is 4 x 4 in., he estimates that his lumber bill for the formwork has been reduced by the value of a good many thousand feet. Moreover, the labor cost of striking the centers is believed to be much less than with solid posts. It is only necessary to cut some of the wire ties on these posts, when the plank bend out under the load and release themselves.

These posts are being used by the National Concrete Company in building a large arch bridge on West Washington Street in Indianapolis.

SHORES MADE OF BOARDS TIED BY WIRES EASILY REMOVED BY CUTTING TIES

Flag Indicates Location of Road Patrolman

Each patrolman on the Maryland state highway service is furnished with a cap on which is stamped in gold letters "State Patrolman," a number which he wears on his arm and a red flag. The latter he places in the ground on the section on which he is working so that if the inspector or resident engineer passes he knows that the patrolman is near the flag.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

State Accepts Cash Bid for Illinois Water Power

Sanitary District of Chicago's Bid of $15.01 per Horsepower-Year for Power at Joliet Accepted—To Develop Present Flow at Once

At a final conference on the transfer of the water-power site at Jackson Street, Joliet, Ill., formerly leased to the Public Service Company of Northern Illinois and now transferred to the Sanitary District of Chicago, Governor Dunne accepted the cash bid of the Sanitary District. The action completes a twenty-year lease under the terms of which the state will receive $15.01 a year per horsepower. The Sanitary District is under obligation immediately to develop 7000 hp. from the present flow.

It is expected that a suit will be instituted enjoining the district from developing the power, as its state charter does not permit it to engage in such work. If the courts rule in favor of the district, work will probably be started early next year. Otherwise the development will be indefinitely postponed.

Bids Called for Site

The dam and power site at Joliet have been developing about 3000 kw. and for sixty years have been held by the Economy Light & Power Company, now subsidiary of the Public Service Company of Northern Illinois. Sixty years ago the Illinois & Michigan Canal Commission granted the Economy Light & Power Company a twenty-year lease on the power site, with provisions for two twenty-year renewals, for which rights the Economy company paid the state approximately $9,500 yearly. The last of the renewal periods expired July 17.

At that time Governor Dunne decided that the lease was not again renewable and called for bids. When they were opened on July 15 Andrew J. Cook was the sole bidder, offering $1.50 per horsepower-year for the site. At that time a movement was being discussed at Washington to restrict the flow of water to 25,000 cu. ft. per second in the channel of the drainage canal. That prevented the Sanitary District from bidding, in spite of the fact that in 1903 it had invested $500,000 in a dam at the Economy power site.

First Bids Rejected

The first lone bid of June 15 was rejected and bids were asked again for July 17. Before that date the Sanitary District succeeded in defeating the movement to limit the flow. When the second set of bids was opened it was found that Andrew J. Cook had bid $3 per horsepower-year and that the Sanitary District had presented two bids. These bids were made with the understanding that the lessor should put in machinery and develop 7000 hp. The first bid—the one that has been accepted—was a cash offer of $15.01 per horsepower-year for all power that could be developed. The second bid offered immediately to construct locks at Lockport and Joliet as a step in a Lakes-to-Gulf waterway, and do other work in the channels of the Desplaines River and the Illinois & Michigan Canal at a probable cost of $1,500,000. In addition the Sanitary District was to pay $1 per horsepower for all power developed in excess of 7000 hp. at high-water stages and at any other times. The lease was to be for twenty years, at the end of which period four-fifths of the plant and works would go to the state and the remainder to the successful bidder.

It is understood that the bid offered by Andrew J. Cook was made for the Public Service Company of Northern Illinois. The reasons why the site was not considered more valuable by that company are: That it does not fit in with the company's general plan of using large generating stations with its transmission and distribution systems; that energy can be made in its steam station with an ultimate rating of 60,000 kw. now under construction near Joliet almost as econonmically as in waterwheel units, and that the water-power plant, lying in the center of the city as it does, presents formidable difficulties in high-tension line construction.

Strike Averted—Trainmen Will Treat with Mediation Board

The danger of a nation-wide railroad strike was at least temporarily averted Wednesday of this week, when the leaders of the four brotherhoods agreed to accept the proffer of the Federal Board of Mediation and Conciliation of their friendly offices "provided it was promptly exercised." The railroad managers had refused to grant the employees' demands, and had asked the brotherhoods to join them in an appeal to the federal board for mediation. The union leaders refused to join in the appeal, but accepted the offer of services made by the board.

As the matter stands now the mediators may succeed in adjusting the controversy, they may bring about arbitration or they may be unable to accomplish anything. In the latter event it is believed that President Wilson will call the leaders of both sides of the dispute into personal conference in the effort to avoid a strike.

Erie, Pa., Celebrates Beginning of Flood-Control Work

The formal inauguration of the movement to control floods in Mill Creek was held Aug. 3 at Erie, Pa. It was just a year before that day that an unprecedented rainfall transformed Mill Creek into a raging torrent that took thirty-nine lives and destroyed $3,000,000 worth of property. Mayor Miles B. Kitts deposited a few shovelfuls of concrete into the foundation of one of the piers for the drift catcher, the initial unit of that flood-control work. An iron box containing the names of the officials of the United States, Pennsylvania, Erie County and the City of Erie and newspaper accounts of the flood was then placed in the foundation.

The main feature of the Mill Creek project is a reinforced-concrete tube 22 ft. inside width and 18 ft. high, which will be bedded into solid rock for more than 2 miles. The cost of that part of the work will be about $1,000,000. Contracts will be let this fall. Farley Gannett, consulting engineer, of Harrisburg, Pa., has charge of the work.

Plan to Develop 2,000,000 Horsepower Below Niagara Falls

A plan to dam the Niagara River below the falls and thereby develop about 2,000,000 hp. has been submitted to the government of Ontario by the Thomson-Porter Cataract Company. T. Kennard Thomson, consulting engineer, New York City, and Peter A. Porter are at the head of the project, which is said to involve an expenditure of $100,000,000.

It is planned to build a dam 100 ft. high about 6 miles below Niagara Falls. That would eliminate the whirlpool and its rapids by making a long, narrow lake. The project will be investigated by a commission of engineers of the Ontario government and then presented to the New York Legislature.

Niagara Hydroelectric Situation Discussed

New York State Legislative Committee Advocating Bill Giving State Control of Diversion for Electrical Development

Apparent neglect on the part of the government to foster the development of Niagara Falls electrochemical industries has caused members of the joint legislative committee of New York State to advocate a bill giving the state absolute control of water diversion for electrical development. The joint state committee, consisting of George C. Thompson and George W. Simpson, state senators, and Joseph D. Kelly, assemblyman, recently held a series of hearings at Niagara Falls, N. Y., at which much evidence was submitted to show the urgent necessity of greater diversion for power development. At the close of the hearing Chairman Thompson said that a bill will be introduced in Congress giving New York absolute control of water diversion for electrical purposes.

Representatives of many large Niagara Falls electrochemical industries told how they have been forced to establish Canadian and even foreign branches because of the great shortage of power on the American side. Water-power authorities expressed the opinion that the scenic beauty would not be impaired by doubling or even tripling the water diversion.

Probably the most important witness before the committee was F. A. J. FitzGerald of Niagara Falls, N. Y., president of the American Electrochemical Society. Mr. FitzGerald urged immediate legislation to extend the diversion limit for power to 20,000 sec.-ft.—the maximum fixed by treaty. That would give an additional 4400 sec.-ft., capable of generating about 80,000 hp. While the additional power would meet present needs, Mr. FitzGerald said this would not provide for future requirements.

Reviews Niagara Development

In reviewing the history of electrical development at Niagara Falls, Mr. FitzGerald said that in 1895 the only industry dependent upon electricity for its product was the Pittsburgh Reduction Company, now the Aluminum Company of America. The Niagara Falls Power Company then had only three generators in operation. Now there are twenty, most of them vastly larger than the first units. Yet, Mr. FitzGerald said, there is not sufficient power to meet the requirements of industrial establishments on the American side of the Niagara River.

The Carborundum Company and the Norton Company both have branch plants in Germany, he said, and they are of the utmost importance to the German Empire in the present war. The Norwegians are receiving the aid of the government in the establishment of electrochemical industries in that country, and no doubt the Germans have plants of that nature in Norway. It is possible to manufacture products in Norway and sell them in New York City as cheaply as those of Niagara electrochemical industries. So the great importance of not forcing the shortage of Niagara products is apparent.

Mr. FitzGerald spoke on the importance of the nitrates and of the necessity in the United States for developing the fixation of atmospheric nitrogen. Given plenty of power, he said, Niagara Falls electrochemists could by developing the fixation of atmospheric nitrogen make the United States absolutely independent in the matter of nitrates.

Investigation of the possibilities of establishing a large electrochemical industry in the State of Utah, where power is abundant, shows that it would cost more to market the product manufactured there than if it were manufactured in Norway.

Show Need for More Power

Frank J. Tone of the Carborundum Company, said that the inability of American manufacturers to obtain power was forcing American industry to Canada and European countries. He said that not only the Carborundum Company but other Niagara Falls industries have established large branches on the Canadian side of the river, and that one branch has been established in Germany. His company uses 10,000 hp. and needs that much more, but is unable to get it. Other companies also are unable to procure the desired amount of power.

"Doubling and even tripling the diversion of water at Niagara Falls for power development would not impair the scenic beauty of the cataract," said W. A. Jamieson of the William A. Rogers Company, a large silver-plating establishment. "We want to double our capacity, but owing to the great shortage of power we are operating far below our maximum. If we used steam-generated electricity rather than Niagara power our cost of production would increase 225 per cent."

Former Representative Peter A. Porter told of the junior Niagara plan of power development noted elsewhere in this issue. James S. Simmons, former representative from Niagara Falls, also told of plans of the Lower Niagara River Power Company.

W. L. Bliss of the United States Heat & Light Corporation told the committee that while his company uses only 1000 hp. the cutting off of the supply of cheap power would put one branch of the company's business out of existence. He declared that without cheap Niagara power it would be impossible to operate the storage-battery department.

Favors Joint Conference

H. G. Akers of Toronto, Ont., an electrical engineer associated with the Ontario Hydro-electric Commission, attended the hearing to learn the demands of American industries as regards future power developments. Mr. Akers expressed himself in favor of a joint conference between representatives of the United States and Canada for a new international treaty regarding water diversion for power purposes. He said the two countries could develop all the available power of the Niagara and St. Lawrence Rivers and that the Ontario commission is desirous of bringing about such a joint conference.

International Committee May Settle Niagara Power Question

Hearings begun four years ago by the House Foreign Affairs Committee on legislation to regulate diversion of water at Niagara Falls for generation of electricity were closed last week. Before Congress adjourns the committee plans to report a bill based on that introduced by Representative Cline of Indiana for co-operation with Canada in preserving the scenic beauty of the falls and at the same time developing the hydroelectric resources. Indications are that a joint international commission to limit the diversion of water will be recommended.

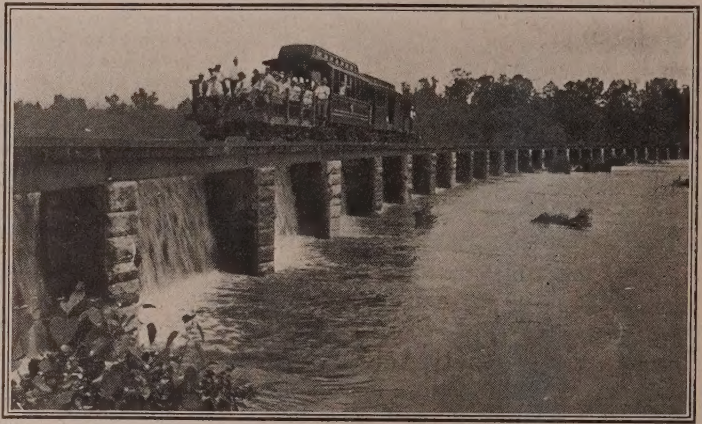
Final statements supporting the claim of New York State to make use of the water diverted were presented by the committee of the New York State Legislature mentioned in the preceding article. They expressed a belief that the federal government may control the amount of water which shall be diverted, but that its use should be granted to the state for development with any accruing revenue. They also suggested that the boundary waterways treaty with Canada be enlarged to develop power projects all along the border.

Form Australia Water Commission

Under the irrigation amendment act which was recently made a law, the Water Conservation and Irrigation Commission of Australia has been organized. W. C. Grahame, Minister of Agriculture, automatically becomes chairman of the commission. The other newly appointed members are H. H. Dare and W. Neville Sendall. The water department was formerly controlled by only one commissioner.

Engineers Investigate Nitrate Plant Locations in South

Citizens from practically all of the Southern states met recently at Nashville, Tenn., to formulate plans and begin the collecting of data to show that the best possible location for the proposed $1,000,000 government nitrate plant is at one of several points in the South. During the convention $15,000 was pledged to defray the committee's expenses in presenting the advantages of Muscle Shoals as the best site for a nitrate plant, and $3,500 was voted for an investigation by engineers. The relative merits of Muscle Shoals, Keokuk Falls and Priest Rapids as sites for a nitrate plant will be set forth by an engineering committee of members of the Engineering Association of the South.



MEMBERS OF ENGINEERING ASSOCIATION OF THE SOUTH INSPECT MUSCLE SHOALS' POSSIBILITIES AS A SITE FOR NITRATE PLANT

PICTURE SHOWS AQUEDUCT WHICH CARRIES MUSCLE SHOALS CANAL OVER SHOAL CREEK

Preceding the convention members of the Nashville section of the Engineering Association of the South made a trip over Muscle Shoals on the Tennessee River. As much data as possible were collected and a report made to the meeting at Nashville.

Hearing Aug. 16 on Concrete Bridge at Ocean City, Md.

Major J. C. Oakes, U. S. Army engineer in charge of the Wilmington (Del.) division, has arranged with H. G. Shirley, chief engineer of the Maryland State Road Commission, for a hearing Aug. 16 at Ocean City, Md., on the construction of a concrete bridge to connect Ocean City with the mainland. The last legislature appropriated $125,000 for the proposed structure to replace the present wooden bridge. The plans made by the Maryland Road Commission are claimed to necessitate an expenditure of only $95,000.

$100 for News of Engineer

Edwin S. Hadlock, a civil engineer in the employ of the Baltimore & Ohio Railroad, has disappeared. He was last identified in Cincinnati on June 21. Mr. Hadlock had drawn about $700 from a bank in Cincinnati and started for Portland, Me. Although the last news of him came from Cincinnati, his trunk arrived in New York City and was rechecked to Boston. Also, someone used his railway pass from Cincinnati to New York. Mr. Hadlock is thirty-nine years old, 5 ft. 7½ in. tall and weighs about 170 lb. His father, Samuel Hadlock, of Portland, Me., offers $100 for information as to the whereabouts of the son.

Proposed Dam to Raise Water Level 300 Feet

Irrigation Project on Kings River, California, Involves 1,000,000-Cubic Yard Structure—Power for Drainage Pumps Planned

All the irrigation districts supplied with water from Kings River in the central-southern section of California have joined in planning a storage reservoir which would be generally beneficial to the lands affected. The scheme consists of a storage dam across the cañon of Kings River just below Pine Flat, which will be of a height sufficient to store 600,000 acre-feet. The dam will raise the water approximately 300 ft., which is said to be 50 ft. more than the water-level raise behind any dam yet constructed.

An arched masonry structure is contemplated, the volume of which would be about two and one-half times that of the Roosevelt dam. About 1,200,000 acres are to be served, and it is believed that the cost of the development can be kept down to a much lower figure per acre than has been considered feasible in other large projects. Only about 4 miles of railroad construction will be required, and the entire work could be finished, it is thought, in about three years.

A part of the development consists of the installation of pumping units to keep the water plane over the whole area down to a desirable depth and at the same time to utilize this water for the land in need of it. A power plant located at the dam would supply power for the pumping stations. There is an area of approximately 100,000 acres on the territory involved where the water plane is only about 4 ft. from the surface, and in a large tract south and west of Fresno seepage conditions are said to have become a serious problem. The average annual flow of Kings River for the past twenty years is about 2,000,000 acre-feet. It is considered feasible to utilize only 1,700,000 acre-feet.

No borings have been made at the dam site, but bedrock shows on both side walls of the cañon. From the shape of the bedrock where it passes out of sight under the river it is believed that the distance to bedrock in mid-stream would not be great. A rough estimate shows that the probable volume of the dam will be about 1,000,000 cu. yd., including the masonry which will go into the spillway and other structures.

The water users of the district organized and appealed to Washington for aid in developing the Kings River reservoir site. At the request of the federal government Louis C. Hill, of Los Angeles, investigated the project and has recently submitted a report in which the foregoing information is embodied.

Form New Engineer Company

Upon the discovery that twenty-nine civil engineers were members of F Company, 4th Pennsylvania Infantry, at El Paso, Tex., orders were issued incorporating the company into the Pennsylvania battalion of engineers. The new unit will be known as Company C.

Build Dam Across the Colorado River in Seven Days

As the Imperial valley, California, has been facing a shortage of water because of the scour and rapid falling stage of the Colorado River emergent measures have been taken to maintain the supply. A canal has been rushed through for a supplementary supply direct from Volcano Lake and a rock diversion weir across the Colorado River just below the intake was built to raise the water level at the heading.

The new ditch, known as the Cerro Prieto Canal, is 20 miles long and has a capacity of 1200 sec.-ft. It was built on the west side of New River and involved the moving of more than 800,000 cu. yd. of earth. Construction was begun May 25 and on Aug. 1 the chief engineer announced it would be ready to receive water in a few days.

There was some opposition on the Yuma project to the construction of the rock weir below Handlon heading, as well as considerable delay in securing permission from the War Department. Pile driving was finally commenced on July 27, and on Aug. 1 it was stated that the structure would be finished on Aug. 3. The main channel where the pile trestle and rock weir were thrown across the river is 690 ft. wide and about 15 ft. deep.

Charles R. Rockwood, chief engineer of the Imperial Irrigation District, stated that when the weir was completed the level at the intake should rise within 48 hours so as to supply the Imperial canal with all the water needed.

Engineering Society Activities

The Engineers Club of Seattle, at its regular weekly meeting Aug. 3, was addressed by Frank T. Houlahan on brick making and clay products.

The Seattle Association of Members of the American Society of Civil Engineers held its regular monthly meeting July 31 at the Northold Inn. The relations of the national engineering societies to local sections were discussed.

The Tacoma Branch of the Naval Consulting Board of the United States was recently organized by civil, mechanical, chemical and electrical engineers. G. L. Parker, district engineer of the U. S. Geological Survey, Tacoma, was appointed chairman of the board. Capt. A. O. Powell, president of the Seattle Association of Members of the American Society of Civil Engineers, outlined the work accomplished by the Naval Consulting Board and mentioned the necessity of quickly getting the data in the hands of Washington officials.

The Engineers Society of Pennsylvania will hold an outing Aug. 26 at Pine Grove Furnace, Pa. Several hundred engineers are expected to attend.

What Engineers and Contractors Are Doing

AUSTIN B. FLETCHER, chief engineer of the California State Highway Commission, has been granted a forty-five day leave of absence to become a member of the special federal board which will handle the government's $85,000,000 good-roads appropriation. The appointment was made at the request of the Secretary of Agriculture. Mr. Fletcher has been active in good-roads work since his graduation from Lawrence Scientific School, Harvard University, in 1893. From that year until 1909 he served as secretary of the Massachusetts Highway Commission, resigning to join the highway department of California. To his efforts is attributed the success of the Massachusetts commission with which he was so long associated.

F. C. HITCHCOCK has resigned as vice-president and general manager of the MacArthur Brothers Company to join the Siems Carey Railway & Canal Company in a similar capacity. He will be engaged on extensive work in China. Mr. Hitchcock's first engineering experience was acquired in 1880, in the engineering department of the Toledo, Delphos & Burlington Railroad. The following year he went to the Delphos & Cleveland Railroad, where he was employed for a year on location and construction until his resignation in 1882 to become assistant engineer for the Toledo & Indianapolis Railroad. By studying in such periods as were available for that purpose Mr. Hitchcock fitted himself for a position in the engineering department of the Toledo & Ohio Railroad, with which company he remained from 1883 to 1887. In the latter year he was appointed resident engineer in charge of 10 miles of construction for the Duluth, South Shore & Atlantic Railroad. From 1888 Mr. Hitchcock was for several years employed by different roads on construction work, finally becoming assistant engineer on the Ohio extension of the Norfolk & Western Railway in 1890. He was later promoted to the position of resident engineer, in which capacity he had charge of the construction of 110 miles of roadway, including location and the design of heavy railway structures. He was for a time engineer and manager for George S. Wood & Company, contractors, and later locating engineer for the Choctaw Coal & Railway Company. He has been with the MacArthur Brothers Company for more than ten years.

WILLIAM G. SLOAN, formerly chief engineer for the MacArthur Brothers Company, has been made vice-president to succeed F. C. Hitchcock, whose resignation is noted elsewhere in this issue. Mr. Sloan's promotion comes after nearly fourteen years' service with the MacArthur Brothers Company. After graduation from Cornell University in 1899 he entered the employ of the Illinois Central Railroad as assistant engineer. The following year he was transferred to the Yazoo & Mississippi Valley Railroad in charge of construction of the line from Grenada to Parsons, Miss. He gave up railroad work in 1901 to become engineer in charge of masonry construction at Manchester, England, for the British Westinghouse Electric & Manufacturing Company, where he was employed until his appointment early in the following year as engineer for James Stewart & Company. He joined the MacArthur Brothers Company in December, 1902, and has been successively superintendent, Eastern manager and chief engineer.

M. M. MARSH has been promoted from assistant engineer for the Northern Railway Company of Costa Rica to superintendent maintenance of way and bridges. Mr. Marsh took up railway engineering in 1898 as rodman for the Cleveland, Lorain & Wheeling Railway. When that road was absorbed by the Baltimore & Ohio in 1901 he was made instrumentman in charge of construction of the Medina cutoff, in which capacity he served until his resignation in 1903 to enter the real-estate business. Two years later he again entered the field of railway engineering, with the St. Louis South Western Railway, where he won rapid promotion, and a year later was placed in charge of about 60 miles of grade-reduction work. February, 1908, found him chief of party in the Culebra district of the Isthmian Canal, from which position he resigned in 1913 to become assistant engineer for the Northern Railway Company of Costa Rica, C. A.

C. G. JENNINGS has resigned as rodman for the Morgan Engineering Company to become a junior engineer in the bridge department of the Illinois Highway Commission. While with the Morgan Company Mr. Jennings was engaged on a drainage survey in northeastern Kansas.

E. D. GRIFFITH, who has served as testing engineer for the California State Department of Engineering for the past nine years, was July 1 appointed testing engineer of the State Purchasing Department.

THOMAS EARLE, who has been associated with the Pennsylvania Steel Company's bridge department for more than twenty-five years, has been made vice-president of the recently organized Bethlehem Steel Bridge Corporation. He was formerly vice-president of the Pennsylvania Steel Company of Delaware.

H. B. DICK was recently made district valuation engineer for the Baltimore & Ohio Railroad with jurisdiction over the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton Railway.

C. F. BENNETT has resigned as valuation engineer for the Chicago & Western Indiana Railroad to become cost engineer for the valuation department of the Baltimore & Ohio Railroad. Mr. Bennett has had considerable railroad experience as office engineer for the Lehigh Valley Railroad, assistant office engineer and special engineer for the Canadian Pacific and as office engineer for the Mississippi River & Bonne Terre Railroad.

W. L. HAVENS, a recent graduate in civil engineering at Cornell University, is now employed by the division of sewage disposal of the city of Cleveland, Ohio.

ALBERT W. JOHNSTON, who was recently promoted from general manager of the New York, Chicago & St. Louis Railroad to become assistant to the president, obtained his early railroad experience in the engineering departments. After graduation from Massachusetts Institute of Technology he entered railway service as clerk and draftsman in the general superintendent's office of the Pittsburgh, Cincinnati & St. Louis Railway. He was made assistant engineer in 1878 and served in that capacity until his appointment to the superintendency of the St. Louis Southwestern Railway in 1880. He was appointed chief engineer for the Toledo, Delphos & Burlington Railroad early in 1882 but resigned in April of that year to go to the Leavenworth, Topeka & Southwestern Railroad as superintendent. He went to the New York, Chicago & St. Louis as division engineer in 1884. From 1884 to 1889 he was division engineer and following four years superintendent of the Eastern division. He was made general superintendent in 1893 and general manager in 1906.

R. S. WELCH, formerly assistant engineer of the Baltimore & Ohio Railroad in the office of the district engineer maintenance of way at Cincinnati, has been transferred to the Indiana division as assistant division engineer.

R. W. GABRIEL has been promoted from assistant engineer of the Ohio division of the Baltimore & Ohio Railroad to assistant engineer in the office of the district engineer maintenance of way for the Southwest district, with headquarters at Cincinnati.

W. P. ABBOTT, formerly assistant supervisor of the Ohio division of the Baltimore & Ohio Railroad, has been advanced to assistant division engineer of the Ohio division, with office at Chillicothe, Ohio.

EDGAR H. BAKER, who for the last year has been employed by the Interstate Commerce Commission, Southern District, division of valuation, has resigned. He is now in the valuation department of the Baltimore & Ohio Southwestern Railroad, with headquarters at Cincinnati.

A. H. MYERS has resigned as engineer for the William Russel Smith Company of York, Pa., to take a similar position with the B. F. Goodrich Company, Akron, Ohio.

L. N. MOELLER recently resigned as instructor in the surveying department at the Columbia University summer school to enter the technical department of the Atlas Portland Cement Company, Chicago. He was connected with the Atlas Portland Cement Company for nearly four years previous to joining the faculty of Columbia University, from which he has just received the degree of civil engineer.

John S. Randall, whose duties include the supervision of the erection and repair of coast-guard buildings, jetties and wharves, is now located at Beaufort, N. C., where he is superintending construction work.

C. P. Griffith, architectural engineer for Ray & Sons, building contractors, of Louisiana, Mo., is superintending the erection of a $45,000 school at Roberts, Ill., for which his company was recently awarded the contract.

S. S. Carroll, for five years deputy state engineer of New Mexico, has been appointed resident engineer for the Las Vegas grant board. He will have charge of the construction of the Sanguijuela irrigation system. He was graduated from the University of Missouri in 1898. Mr. Carroll was at different periods employed by the Slupp Brothers Bridge & Iron Company and the Missouri Pacific & Iron Mountain Railroad. He served later as assistant engineer and superintendent of construction at Ignacio, Col., and Shiprock, N. M., for the U. S. Reclamation Service.

Melvin C. Hazen has been appointed to his third term as surveyor for the District of Columbia. He has been in the employ of the District since 1889, when he entered its service as transitman. He rose to the position of assistant engineer in 1896, and nine years later became assistant surveyor. His first appointment as surveyor was in 1908. The surveyorship is the oldest and the only office in the engineer department, except that of steam-boiler inspector, to which appointment is made for a definite number of years.

James W. Billingsley, consulting engineer, of New Orleans, was recently engaged to plan and supervise the construction of a system of modern highways in Louisiana. The work has been divided into two districts, each of which has voted a $250,000 bond issue. Carl McHenry is chairman of the first road district; T. P. Flournoy has charge of the second.

W. N. Hall, drainage engineer for the U. S. Department of Agriculture, has been transferred from his station in Texas to the Washington office. His work in the Southwest included the investigation of the drainage of irrigated lands.

A. C. Shepard, formerly in the U. S. engineer's office at Cincinnati, has been placed in charge of the improvement of the mouth of the Big Sandy River, with headquarters at Catlettsburg, Ky.

G. C. Caywood, in the employ of Zitterell & Sullivan, contractors, of Webster City, Iowa, is now located at Ackley, Iowa, where he is building a sewage-disposal plant for that municipality.

Samuel J. Hoexter has resigned from the faculty of the University of Michigan and from the secretaryship of the Michigan Engineers' Society to become manager of the Engineers' Society of Pennsylvania. Mr. Hoexter is a graduate of Stevens Institute of Technology, class of 1909. He has been a member of the mechanical engineering faculty of the University of Michigan for the last four years.

C. H. Howe, division engineer for the Baltimore & Ohio Southwestern Railroad, has been transferred from Flora, Ill., to Chillicothe, Ohio.

George W. Spencer, city engineer of Huntington Beach, Cal., has been made city manager.

H. L. Wiley, contract manager of the Beers Building Company's Seattle office, has resigned. He has announced no plans for the future.

Jay H. Keller, consulting engineer, of Portland, Ore., has been made superintendent of mechanical equipment in the new municipal auditorium now under construction. He is to serve as inspector while the structure is being erected.

Walter H. Graves, consulting engineer, of Portland, Ore., has entered the employ of the Crawford Point Oregon Townsite Company. Mr. Graves has been engaged in engineering since his graduation from Illinois Wesleyan University in 1872.

Fred W. Osgood, assistant engineer under Frank H. Stephenson on plans and studies for the Cleveland (Ohio) filtration plant since February, 1914, is on temporary leave from the city service. He is at present engaged on work at Lima, Ohio, for R. Winthrop Pratt, of Cleveland, and William C. Clark, of Toledo, consulting engineers for Lima's new waterworks. A survey and map of the new 130-acre reservoir will be made and data collected from which to prepare plans for the filter and the enlargement of the pumping station.

F. X. Bode has been appointed deputy city engineer of Troy, N. Y., to succeed J. C. Watts, resigned.

Robert L. Burwell has resigned from the Baltimore (Md.) Sewerage Commission upon the completion of that project. As assistant engineer he had charge of a large amount of storm-water and sanitary construction, in addition to being resident engineer during the erection of the sewage-pumping station. As assistant division engineer he prepared contract plans and specifications for more than $3,000,000 worth of work. He expects to devote his time in the future to work along similar lines. He was with the commission for nine years.

R. D. Waugh, Mayor of Winnipeg, Canada, has been appointed chairman of the Commission of the Greater Winnipeg Water District to succeed the late S. H. Reynolds.

Fred A. Robertson has resigned as a member of the engineering staff of the Canada Cement Company to accept a position with the Ontario Hydroelectric Power Commission.

James F. Tabler has resigned as transitman on forest surveying and timber estimating for the Champion Lumber Company, of Crestmont, N. C. He is now transitman on valuation work for the Marion & Rye Valley Railway. Mr. Tabler was graduated from the Carnegie Institute of Technology in 1913.

Louis E. Ayres, after eight years of continuous service with Gardner S. Williams, consulting engineer, of Ann Arbor, Mich., has resigned to join the Belle Isle Bridge Commission of Detroit. The commission was recently appointed to prepare plans and estimates for the new bridge to Belle Isle.

E. G. Hopson, of Portland, Ore., consulting engineer for the U. S. Reclamation Service, has been appointed by Secretary Lane of the Department of the Interior a member of a board that will review irrigation possibilities of the upper Colorado watershed in the state of Wyoming. The Secretary of the Interior appoints one member, the Governor of Wyoming another and the third is selected by the two appointees. Mr. Hopson has been engaged in engineering work since 1886 and has been connected with the U. S. Reclamation Service since 1906. He was for five years engaged on the building of the Hopkinton, Whitehall and Sudbury reservoirs for the city of Boston, following which he was employed on the Wachusett reservoir and aqueduct construction. During 1901-02 he was a member of the firm of Hopson Brothers, Halifax, Nova Scotia. He spent the following year as engineer in the department of aqueducts and reservoirs of New York and then became chief engineer for the National Board of Fire Underwriters. His appointment to the U. S. Reclamation Service followed.

Ralph G. Kirk has resigned as superintendent of construction at the Steelton plant of the Bethlehem Steel Company. He has announced no plans for the future.

J. M. Johnson, consulting engineer, of Louisville, has been engaged to examine and approves plans for a new $750,000 pump house for the Louisville Water Company.

Lieut.-Col. William V. Judson, Corps of Engineers, U. S. A., has been transferred from Chicago to Baltimore to succeed Col. C. A. F. Flagler, who was temporarily in charge of that district. Since his graduation from West Point in 1888 Lieutenant-Colonel Judson was in charge of harbor improvement at Toledo, improvement of the Mississippi River between Clarksville, Mo., and the mouth of the Missouri River and jetty construction at Galveston, Tex. Since 1914 he has been in charge of river and harbor improvements at Chicago.

Obituary Notes

A. B. Stickney, founder of the Chicago Great Western Railroad, died Aug. 9 at his home in St. Paul. He entered railway service in 1871 and was for several years an executive of the St. Paul, Stillwater & Taylor Falls Railway. Following his connection with the St. Paul, Minneapolis & Manitoba Railway as superintendent of construction he was general superintendent for the Canadian Pacific and later joined the Minneapolis & St. Louis in an executive capacity. He built the Minnesota Central Railway and then devoted his time to the Minnesota & Northwestern Railway, of which he was president. In 1892 he became chairman of the board of directors of the Chicago Great Western Railway and later was elected to its presidency.

Peter S. Gibson, head of the firm of Peter S. Gibson & Sons, engineers and land surveyors, of Toronto, died Aug. 8 in that city. He was for thirty-five years engineer for York Township and a member of the board of examiners of the Ontario Land Survey. He was a graduate of the University of Michigan.

Thomas Appleton, founder and first president of the Society of Constructors of Federal Buildings, died Aug. 3, at Gardiner, Me.

Charles A. Stoess, one of the oldest civil engineers in British Columbia, died recently at his home in Vancouver. He came from England to Canada twenty-seven years ago. After serving in the civil engineering department of the Canadian Pacific Railway for many years and helping build the line through the Rocky Mountains he was employed on the Kelowna irrigation project.

Arthur Hider, principal assistant engineer for the Mississippi River Commission, third district, died at Greenville, Miss., July 28. Mr. Hider has been connected with Mississippi River improvement work since 1879. For the past twenty-five years he was assistant in charge of all the bank-revetment work in the third Mississippi River district and was also in charge of the design and construction of towboats, tugs, hydraulic graders and all the various items required for river improvement. In addition to his work with the Mississippi River Commission Mr. Hider practised consulting engineering. Some of the works on which he so engaged include waterworks systems at Greenville and Hollandale, Miss., and Lake Providence, La. He was also a member of a committee to determine value of the Memphis (Tenn.) waterworks system when it was taken over by the city. Before joining the Mississippi River Commission Mr. Hider was in the city engineer's department at Louisville.